

**LAKE COUNTY
AIR QUALITY MANAGEMENT DISTRICT**
885 Lakeport Blvd., Lakeport, CA 95453



**QUALITY ASSURANCE PROJECT PLAN
(QAPP)
FOR THE
PM_{2.5} AMBIENT AIR MONITORING PROGRAM
FOR STATE AND LOCAL AIR MONITORING STATIONS (SLAMS)**

LAST REVISED - JANUARY 2002

1.0 QUALITY ASSURANCE PROJECT PLAN IDENTIFICATION AND APPROVAL

Title: Lake County Air Quality Management District (LCAQMD) Quality Assurance Project Plan (QAPP) for the PM_{2.5} Ambient Air Monitoring Program at State and Local Air Monitoring Stations (SLAMS)

The attached QAPP for the PM_{2.5} Ambient Air Quality Monitoring Program is herein revised to update the plan and include the Lake County Air Quality Management District laboratory functions. It is hereby recommended for approval as amended, and commits the LCAQMD to follow the elements described within.

Lake County Air Quality Management District (California) LCAQMD

1) Signature: _____ Date: _____
Robert L. Reynolds – Air Pollution Control Officer

California Air Resources Board

1) Signature: _____ Date: _____
William V. Loscutoff – Chief, Monitoring and Laboratory Division

U.S. EPA, Region IX

1) Signature: _____ Date: _____
John Kennedy - Chief, Air Division - Technical Support Office

2) Signature: _____ Date: _____
Vance S. Fong, P.E., - Manager, Policy and Management Division
Quality Assurance Office

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3.0 DISTRIBUTION

A copy of this QAPP has been distributed to the individuals in Table 3-1.

Table 3-1 Distribution List

Agency	No. Copies	Representative
EPA	3	Mr. Manny Aquitania USEPA Region IX Air-7 75 Hawthorne Street San Francisco, CA 94105
ARB	1	Mr. Mike Miguel CARB MLD-QA P.O. Box 2815 Sacramento, CA 95812
LCAQMD	3	Mr. Robert L. Reynolds, APCO Lake County AQMD 885 Lakeport Blvd. Lakeport, CA 95453

4.0 PROJECT/TASK ORGANIZATION

4.1 Roles and Responsibilities

Federal, State and Districts all have important roles in developing and implementing satisfactory air monitoring programs. As part of the planning effort, U.S. EPA is responsible for developing National Ambient Air Quality Standards (NAAQS), defining the quality of the data necessary to make comparisons to the NAAQS, and identifying a minimum set of QC samples from which to judge data quality. The State and Districts are responsible for collecting this information and developing and implementing a quality system that will meet the data quality requirements. Then, it is the responsibility of the U.S. EPA, the State and Districts to assess the quality of the data and take corrective action when appropriate. The responsibilities of each organization follow.

4.1.1 Office of Air Quality Planning and Standards (OAQPS)

OAQPS is the organization charged under the authority of the Clean Air Act (CAA) to protect and enhance the quality of the nation's air resources. OAQPS sets standards for pollutants considered harmful to public health or welfare and, in cooperation with U.S. EPA's Regional Offices and the states, enforces compliance with the standards through state implementation plans (SIPs) and local agencies, such as the Lake County AQMD regulations controlling emissions from stationary sources. The OAQPS evaluates the need to regulate potential air pollutants and develops national standards, works with State and local agencies to develop plans for meeting these standards; monitors national air quality trends and maintains a database of information on air pollution and controls; provides technical guidance and training on air pollution control strategies; and monitors compliance with air pollution standards.

Within the OAQPS Emissions Monitoring and Analysis Division, the Monitoring and Quality Assurance Group (MQAG) is responsible for the over-sight of the Ambient Air Quality Monitoring Network.

4.1.2 U.S. EPA Region IX Office

U.S. EPA Regional Offices have been developed to address environmental issues related to the states within their jurisdiction and to administer and oversee regulatory and congressionally mandated programs. The major quality assurance responsibilities of U.S. EPA's Region IX Office, in regards to the Ambient Air Quality Program are the coordination of quality assurance matters at the Regional level with the State and local agencies. This is accomplished by the designation of U.S. EPA Regional Project Officers who are responsible for the technical aspects of the program.

The California ARB and the District will direct technical and QA questions to Region IX.

4.1.3 California ARB

The ARB's mission is to promote and protect public health, welfare, and ecological resources through effective reduction of air pollutants while recognizing and considering the effects on the economy of the State. By legislative mandate, the ARB has oversight of California's air pollution control program with the responsibility for improving and maintaining the air quality in the State. The state is primarily concerned with the control strategy for vehicles, while local AQMD's have regulatory authority and is responsible for stationary sources.

40 CFR Part 58 defines a State Agency as "the air pollution control agency primarily responsible for the development and implementation of a plan (SIP) under the Act (CAA)". Section 302 of the CAA provides a more detailed description of the air pollution control agency.

A major responsibility of the State is the implementation of a satisfactory monitoring program, which includes the implementation of an appropriate quality assurance program in partnership with the Air Districts of the State. It is the responsibility of State to implement quality assurance programs in all phases of the air monitoring network including the field, their own laboratories, and in any consulting and contractor laboratories which they may use to obtain data. The network operations are defined as work performed, to obtain, use, or report information pertaining to environmental processes or conditions. It is the responsibility of the ARB to implement, assist and/or insure the implementation of air monitoring program(s), and quality assurance program(s). The District, when staff, and financially able, assist the State in meeting these responsibilities and carry out air monitoring programs.

4.1.4 Lake County Air Quality Management District

The Lake County Air Quality Management District's (LCAQMD) mission is to protect public health and welfare within Lake County, by improving and maintaining local air quality, with the cooperation and assistance from the California Air Resources Board and Federal EPA.

A shared ARB/LCAQMD responsibility is the implementation of a monitoring program, which includes data quality assurance. The quality assurance program covers all phases of the air monitoring network, including field and laboratory operations, as well as any consulting and contractor laboratories which are used in the monitoring program. The ARB works in cooperation and supports the efforts of the District.

At full staff, the LCAQMD includes 5 employees: the Air Pollution Control Officer (APCO), Deputy Air Pollution Control Officer (DAPCO), Air Quality Engineer (AQE), Air Quality Specialist (AQS), and an Air Quality Office Technician (AQOT).

The following sections describe staff roles for the QAPP. We are a small agency emphasizing cross training, and while the responsibilities are as indicated, they may at times be carried out by other staff.

4.1.4.1 Air Pollution Control Officer

Director / Air Pollution Control Officer – Robert L. Reynolds

The Air Pollution Control Officer (APCO) serves the District's Board of Directors which may delegate any duty to the APCO that District's Board of Directors deems appropriate. The APCO performs and discharges, under the direction and control of the District's Board of Directors the powers and duties vested in the APCO by state and federal law, and delegated to the APCO by the District's Board of Directors.

- Provides support, direction, and resources to the Deputy Air Pollution Control Officer and Air Quality Engineer to ensure the successful operation of the District's Air Quality Monitoring Program.
- writes and maintains the PM2.5 QAPP, and the District's SOP for Air Quality Monitoring

4.1.4.2 Deputy Air Pollution Control Officer

Deputy Air Pollution Control Officer – Ross L. Kauper

Provides accurate ambient air monitoring data measurements to define the nature extent and trend of air quality within Lake County. Also provides expert technical support for the LCAQMD's Air Quality Monitoring Program.

- develops and improves laboratory methods and procedures
- assures that highly complex and sensitive instrumentation functions properly
- conducts correlation testing and repair of complex instrumentation
- maintains calibration gases and instrumentation
- collects and analyzes samples
- develops test methods
- provides services as needed to assist the District's AQE and AQS in the administration and operation of the District's Air Quality Monitoring Program

4.1.4.3 Air Quality Engineer

Air Quality Engineer – John D. Thompson

Provides accurate ambient air monitoring data measurements to define the nature extent and trend of air quality within Lake County. Also provides expert technical support for the LCAQMD's Air Quality Monitoring Program.

- develops and improves laboratory methods and procedures
- assures that highly complex and sensitive instrumentation functions properly
- conducts correlation testing and repair of complex instrumentation
- maintains calibration gases and instrumentation
- collects and analyzes samples
- develops test methods
- provides services as needed to assist the District's Air Quality Specialist in the administration and operation of the District's Air Quality Monitoring Program

4.1.4.4 Air Quality Specialist

Air Quality Specialist – (Currently Vacant) QAPP duties performed by the AQE

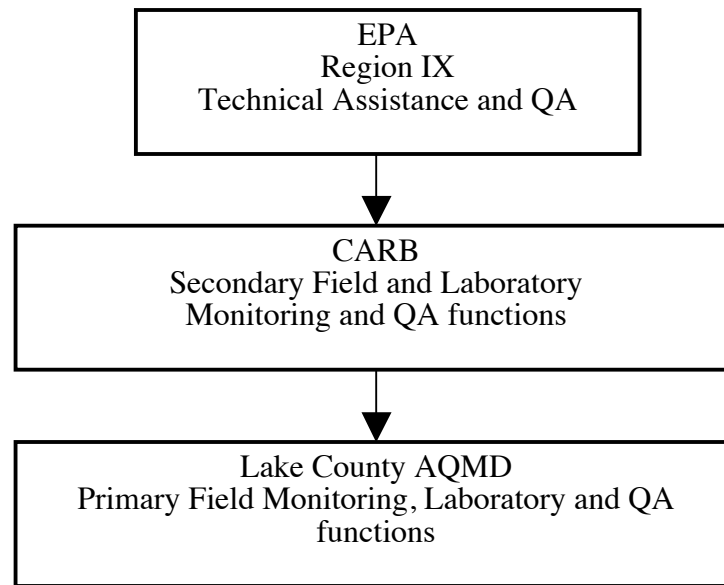
Supports the LCAQMD's Air Quality Monitoring Program by providing accurate ambient air monitoring data measurements to define the nature extent and trend of air quality within Lake County.

- operates a data collection network of air quality monitors
- assures data is scientifically valid and meets stringent air quality standards
- ensures data is processed on a timely manner and made available to local and state officials
- operates the District's balance room, and its sample archive
- writes and maintains the PM2.5 QAPP, and the District's SOP for Air Quality Monitoring
- verifies that all required QA activities are performed and that measurement quality standards are met as required in the QAPP
- transports filters to the laboratory for analysis
- performs balance room functions per SOP
- performs and documents sampler checks as indicated in the SOP

- maintains samplers as indicated in the SOP
- documents all repairs and maintenance performed
- documents deviations from established procedures and methods
- assesses and reports data quality
- prepares and delivers reports to management
- flags suspect data
- coordinates audit activities with EPA and ARB, and respond to audit results if necessary
- ensures conformance with U.S. EPA and ARB requirements
- develops local data management standard operating procedures
- follows good automated data processes
- ensures access to data for timely reporting and interpretation processes

4.2 Organization Chart

As a small District, program success involves the interdependence of monitoring and quality assurance functions.



5.0 Problem Definition and Background

5.1 Problem Statement and Background

Between the years 1900 and 1970, the emission of six principal ambient air pollutants increased significantly. The principal pollutants, also called criteria pollutants, are: particulate matter (PM₁₀, PM_{2.5}), sulfur dioxide, carbon monoxide, nitrogen dioxide, ozone, and lead. In 1969, the first State Ambient Air Quality Standards were promulgated by California for total suspended particulates, photochemical oxidants, sulfur dioxide, nitrogen dioxide, and carbon monoxide. In 1970, the Federal Clean Air Act (CAA) was signed into law. The CAA and its amendments provide the framework for all pertinent organizations to protect air quality. This framework provides for the monitoring of these criteria pollutants by State and local organizations through the Air Quality Monitoring Program.

The criteria pollutant defined as particulate matter is a general term used to describe a broad class of substances that exist as liquid or solid particles over a wide range of sizes. As part of the Ambient Air Quality Monitoring Program, U.S. EPA will measure two particle size fractions; those less than or equal to 10 micrometers (PM₁₀), and those less than or equal to 2.5 micrometers (PM_{2.5}). This QAPP focuses on the QA activities associated with PM_{2.5}.

The background and rationale for the implementation of the PM_{2.5} ambient air monitoring network can be found in the Federal Register. In general, some of the findings are listed below.

The characteristics, sources, and potential health effects of larger or "coarse" particles (from 2.5 to 10 micrometers (mm) in diameter) and smaller or "fine" particles (smaller than 2.5 mm in diameter) are very different.

- Coarse particles come from sources such as windblown dust from the desert or agricultural fields and dust kicked up on unpaved roads from vehicle traffic.
- Fine particles are generally emitted from activities such as industrial and residential combustion and from vehicle exhaust. Fine particles are also formed in the atmosphere from gases such as sulfur dioxide, nitrogen oxides, and volatile organic compounds that are emitted from combustion activities and then become particles as a result of chemical transformations in the air.
- Coarse particles can deposit in the respiratory system and contribute to health effects such as aggravation of asthma. U.S. EPA's "staff paper" concludes that fine particles, which also deposit

deeply in the lungs, are more likely than coarse particles to contribute to the health effects (e.g., premature mortality and hospital admissions) found in a number of recently published community epidemiological studies.

- These recent community studies find that adverse public health effects are associated with exposure to particles at levels well below the current PM standards for both short-term (e.g., less than 1 day to up to 5 days) and long-term (generally a year to several years) periods.
- These health effects include premature death and increased hospital admissions and emergency room visits (primarily among the elderly and individuals with cardiopulmonary disease); increased respiratory symptoms and disease (among children and individuals with cardiopulmonary disease such as asthma); decreased lung function (particularly in children and individuals with asthma); and alterations in lung tissue and structure and in respiratory tract defense mechanisms.

Air quality samples are generally collected for one or more of the following purposes:

- 1) To judge compliance with and/or progress made towards meeting the National Ambient Air Quality Standards and the California Ambient Air Quality Standards,
- 2) To develop, modify or activate control strategies that prevent or alleviate air pollution episodes,
- 3) To observe pollution trends throughout the region, including non-urban areas,
- 4) To provide a database for research and evaluation of effects.

With the end use of the air quality samples as a prime consideration, various networks can be designed to meet one of six basic monitoring objectives listed below:

- Determine the highest concentrations to occur in the area covered by the network
- Determine representative concentrations in areas of high population density
- Determine the impact on ambient pollution levels of significant source or source categories
- Determine general background concentration levels
- Determine the extent of Regional pollutant transport among populated areas, and in support of secondary standards
- Determine the welfare-related impacts in more rural and remote areas

The monitoring network consists of four major categories of monitoring stations that measure the criteria pollutants, including PM_{2.5}. These stations are described below.

The SLAMS consist of a network of ~ 3,500 monitoring stations whose size and distribution is largely determined by the needs of State and local air pollution control agencies to meet their respective SIP requirements. There will be 89 SLAMS PM_{2.5} sites in California.

The National Air Monitoring Stations (NAMS) (~1,080 stations) are a subset of the SLAMS network with emphasis being given to urban and multi-source areas. In effect, they are key sites under SLAMS, with emphasis on areas of maximum concentrations and high population density.

The Photochemical Assessment Monitoring Stations (PAMS) network is required to measure ozone precursors in each ozone non-attainment area that is designated serious, severe, or extreme. The required networks will have from two to five sites, depending on the population of the area. There is a phase-in period of one site per year starting in 1994. The ultimate PAMS network could exceed 90 sites at the end of the five-year phase-in period. It is anticipated that there will be PM_{2.5} monitors located at seven PAMS sites in California.

Special Purpose Monitoring Stations (SPMS) provide for special studies needed by the State and local agencies to support their SIPs and other air program activities. The SPMS are not permanently established and, thus, can be adjusted easily to accommodate changing needs and priorities. The SPMS are used to supplement the fixed monitoring network as circumstances require and resources permit. If the data from SPMS are used for SIP purposes, they must meet all QA and methodology requirements for SLAMS monitoring. SPMS have not yet been identified in California, though it is anticipated that there will be 37 speciation samplers operating in the statewide network.

This QAPP focuses only on the QA activities of the SLAMS and NAMS network and the objectives of this network which include any sampler used for comparison to the National Ambient Air Quality Standards (NAAQS).

Throughout this document, the term “decision maker” will be used. This term represents individuals that are the ultimate users of ambient air data and therefore may be responsible for activities such as setting and making comparisons to the NAAQS, and evaluating trends. Since there is more than one objective for this data, and more than one decision maker, the quality of the data (see Element 7) will be based on the highest priority objective, which was identified as the determination of violations of the NAAQS. This QAPP will describe how the LCAQMD PM_{2.5} Ambient Air Quality Monitoring Program intends to control and evaluate data quality to meet the NAAQS data quality objective.

6.0 Project/Task Description

6.1 Description of Work to be Performed

In general, the measurement goal of the PM_{2.5} Ambient Air Quality Monitoring Program is to estimate the concentration, in units of micrograms per cubic meter ($\mu\text{g}/\text{m}^3$), of particulates less than or equal to 2.5 micrometers (μm) that have been collected on a 46.2mm polytetrafluoroethylene (PTFE) filter. For the SLAMS/NAMS network, which is what this QAPP describes, the primary goal is to compare the PM_{2.5} concentrations to the annual and 24-hour National Ambient Air Quality Standard (NAAQS). The national primary and secondary ambient air quality standards for PM_{2.5} are 15.0 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) annual arithmetic mean concentration and 65 $\mu\text{g}/\text{m}^3$ 24-hour average concentration measured in ambient air. A description of the NAAQS and its calculation can be found in the 1997 Federal Register Notice. In addition, Appendix L of part 50 also provides the following summary of the measurement principle:

“An electrically powered air sampler draws ambient air at a constant volumetric flow rate into a specially shaped inlet and through an inertial particle size separator (impactor) where the suspended particulate matter in the PM_{2.5} size range is separated for collection on a polytetrafluoroethylene (PTFE) filter over the specified sampling period. The air sampler and other aspects of this reference method are specified either explicitly in this appendix or generally with reference to other applicable regulations or quality assurance guidance.

Each filter is weighed (after moisture and temperature equilibration) before and after sample collection to determine the net weight (mass) gain due to collected PM_{2.5}. The total volume of air sampled is determined by the sampler from the measured flow rate at actual ambient temperature and pressure and the sampling time. The mass concentration of PM_{2.5} in the ambient air is computed as the total mass of collected particles in the PM_{2.5} size range divided by the actual volume of air sampled, and is expressed in micrograms per actual cubic meter of air ($\mu\text{g}/\text{m}^3$).”

The following sections will describe the measurements required for the routine field and laboratory activities for the network. In addition to these measurements, an initial set of measurements will be required to fulfill the requirements of the AIRS database.

6.2 Field Activities

The performance requirements of the air sampler has been specified in Part 50, Appendix L of the 7/18/97 Federal Register Notice. The interested reader can also refer to Table 6.0.1 in the LCAQMD QAPP, which summarizes some of the more critical performance requirements.

The air samplers will be purchased, distributed, and certified by the U.S. EPA as meeting the requirements specified in the Federal Register. Therefore, the LCAQMD assumes the sampling instruments to be adequate for the sampling for PM_{2.5}. Other than the required federal reference or equivalent air sampler, there are no special personnel or equipment requirements. Element 15 lists all the equipment requirements for the LCAQMD PM_{2.5} data collection operations.

6.2.1 Field Measurements

Presented in the Federal Register as Table L-1 of Appendix L are the field measurements that must be collected. The interested reader can also refer to Table 6.0.2 in the LCAQMD QAPP, which summarizes the requirements. These measurements are made by the air sampler and are stored in the instrument for downloading by the field operator during routine visits.

In addition to the measurements collected in Table L-1 of Appendix L and Table 6.0.2, the additional information contained and explained in *Guidance Document 2.12* will be recorded.

6.3 Laboratory Activities

The Lake County AQMD established their balance room in 2000 and was certified by the CARB in March of 2001. Laboratory activities include the PM_{2.5} filter preparation, (conditioning, pre-weights), post run analysis (conditioning, post weights), data handling, and coordination with EPA for AIRS.

6.3.1 Laboratory Measurements

The Lake County AQMD is now certified to perform the necessary laboratory operations for the PM_{2.5} program. Pursuant to the guidelines, the Lake County AQMD has developed and follows a laboratory SOP. All measurements conform to the requirements of the program SOP, and ARB guidance.

6.4 Project Assessment Techniques

An assessment is an evaluation process used to measure the performance or effectiveness of a system and its elements. As used here, assessment is an all-inclusive term used to denote any of the following: audit, performance evaluation (PE), management systems review (MSR), peer review, inspection, or surveillance. Definitions for each of these activities can be found in the glossary (Appendix A). Element 20 discusses the details of the ARB's assessments. The Assessment Schedule is as follows:

System Audit	EPA	- 1 Every 3 years
	ARB	- 1 st year
Network Review	EPA	- every year
	ARB	- 1/year
FRM Perform. Evaluation	EPA	- 25% of sites/year/4 times per year
Data Quality Assessment	ARB	- every year

The ARB's Quality Assurance Section (QAS) will pre-certify all PM_{2.5} laboratories which is a condition for submittal of PM_{2.5} data to the U.S. EPA's AIRS. The QAS will conduct system audits of laboratories during their first year of operation following pre-certification. Additionally, they will conduct annual PM_{2.5} laboratory performance audits of the micro-balances and relative humidity and temperature sensors and will review the laboratories' quarterly QC reports. If problems are identified during the laboratory performance audits and with the QC reports, additional system audits will be scheduled.

6.5 Schedule of Activities

The following list details the progression of the PM2.5 program:

1/15/98	Network Development (ARB)
3/2/98	Sample Order (ARB)
2/1/98	Lab Design (ARB)
4/1/98	Lab Procurement (ARB) & Personnel Requirements (ARB)
9/1/98	QAPP Development (LCAQMD/ARB)
7/1/98	Network Design Completion (ARB)
7/1/98	Samplers Arrive (ARB)
11/1/98	Sampler siting & testing (LCAQMD)
8/1/98	Training (LCAQMD/ARB)
11/1/98	Draft QAPP Submittal (LCAQMD)
12/1/98	QAPP Approval
11/1/98	Pilot Testing (ARB)
11/1/98	Installation of PM2.5 Site (LCAQMD)
1/1/98	Program Sampling Begins (LCAQMD)
4/1/01	Laboratory (balance room) certified
7/1/01	LCAQMD Balance Room operations start
1/25/02	Revised/Updated QAPP Submittal

6.6 Project Records

The LCAQMD will establish and maintain procedures for the timely preparation, review, approval, issuance, use, control, revision and maintenance of documents and records. The categories covered include Management and Organization, Site Information, Environmental Data Operations, Raw Data, Data Reporting, Data Management, and Quality Assurance. Information on key documents in each of the above categories are explained in more detail in Element 9.

References

- 1) U.S. EPA (1997a) National Ambient Air Quality Standards for Particulate Matter – Final Rule. 40 CFR Part 50. Federal Register, 62(138):38651-38760, July 18, 1997.
- 2) U.S. EPA Quality Assurance Guidance Document 2.12: Monitoring PM2.5 in Ambient Air Using Designated Reference or Class I Equivalent methods, March 1998.

7.0 Quality Objectives and Criteria for Measurement Data

7.1 Data Quality Objectives (DQOs)

Data quality objectives (DQOs) are qualitative and quantitative statements derived from the DQO Process that clarify the monitoring objectives, define the appropriate type of data, and specify the tolerable levels of decision errors for the monitoring program. By applying the DQO Process to the development of a quality system for PM2.5, the U.S. EPA guards against committing resources to data collection efforts that do not support a defensible decision. During the months from April to July of 1997, the DQO Process was implemented for the PM2.5. The objective is to control precision and bias in order to reduce the probability of decision errors.

The DQO is based on the annual arithmetic mean National Ambient Air Quality Standards (NAAQS). The PM2.5 standards are a 15 ug/m³ annual average, and a 65 ug/m³ 24-hour average. The annual standard is met when the 3-year average of annual arithmetic means is less than or equal to 15 ug/m³. Due to rounding, the 3-year average does not meet the NAAQS if it equals or exceeds 15.05 prior to rounding. The 24-hour average standard is met when the 3-year average 98th percentile of daily PM2.5

concentrations is less than or equal to 65 ug/m³.

AIRS PM_{2.5} data were reviewed for two purposes: (a) to determine the relative importance of the two standards; and (b) to suggest reasonable hypothetical cases for which decision makers would wish to declare attainment and non-attainment with high probability. Twenty-four sites were found to have at least one year of PM_{2.5} data in AIRS. The DQOs discussed in the remainder of this document focus on attainment with the annual average standard.

Normal Distribution for Measurement Error. Error in environmental measurements is often assumed to be normal or lognormal. In the case of PM_{2.5}, the measurement error is expected to be in the range of 5 to 10% of the mean, where normal or lognormal errors produce close to identical results. Therefore, due to these comparable results and its simplicity in modeling, the normal distribution of error was selected. Decision errors can occur when the estimated three-year average differs from the actual, or true, three-year average.

Errors in the estimate are due to population uncertainty (sampling less frequently than every day) and measurement uncertainty (bias and imprecision). The false positive decision error occurs whenever the estimated three-year average exceeds the standard and the actual three-year average is less than the standard. The false negative decision error occurs whenever the estimated three-year average is less than the standard and the actual three-year average is greater than the standard.

The limits on precision and bias are based on the smallest number of sample values in a three-year period. Since the requirements allow one-in-six day sampling and a 75% data completeness requirement, the minimum number of values in a three-year period is 137. It can be demonstrated that obtaining more data, either through more frequent sampling or the use of spatial averaging, will lower the risk of attainment/non-attainment decision errors at the same precision and bias acceptance levels.

By reviewing available AIRS data and other PM_{2.5} comparison studies, it was determined that it was reasonable to allow measurement imprecision at 10% CV. While measurement imprecision has relatively little impact on the ability to avoid false positive and false negative decision errors, it is an important factor in estimating bias. When CV is greater than 10% it makes it difficult to detect and correct bias problems.

7.2 Measurement Quality Objectives (MQOs)

Once a DQO is established, the quality of the data must be evaluated and controlled to ensure that it is maintained within the established acceptance criteria. In order to meet DQO, guidelines must be put in place to insure the accuracy and proper interpretation of the data collected. Measurement Quality Objectives (MQOs) are designed to evaluate and control various phases (sampling, preparation, analysis) of the measurement process to ensure that total measurement uncertainty is within the range prescribed by the DQOs. Information regarding these objectives and their use can be found in the U.S. EPA's Quality Assurance Handbook, Volume II. MQOs can be defined in terms of the following data quality indicators:

Accuracy - Accuracy has been a term frequently used to represent closeness to truth and includes a combination of precision and bias error components. This term has been used throughout 40 CFR and in some of the Elements of this document. Based on performance audits, PM_{2.5} flow data shall be within +/-4% of the true value.

Precision - a measure of mutual agreement among individual measurements of the same property usually under prescribed similar conditions. This is the random component of error. Precision is estimated by various statistical techniques using some derivation of the standard deviation. For ambient particulate concentration measurements, precision shall be expressed in terms of a coefficient of variation.

Bias - the systematic or persistent distortion of a measurement process which causes error in one direction. Bias will be determined by estimating the positive and negative deviation from the true value as a percentage of the true value.

Representativeness - a measure of the degree which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. Spatial and temporal data representativeness shall be achieved by assuring that criteria are met for station siting as defined in federal regulations, and that air quality measurements and statistics are compiled.

Detection Limit - a measure of the capability of an analytical method to distinguish low concentrations of a specific analyte.

Completeness - a measure of the amount of valid data obtained compared to the amount that could have been obtained under correct and normal conditions. Data completeness requirements are included in the reference methods (40 CFR 50). In addition, the District will strive to obtain at least 85% data completeness, while maintaining the precision and accuracy objectives. Data completeness (DC) for a single pollutant at a single site is defined as:

$$\%DC = \frac{\text{total number of samples possible} - \text{Samples lost to calibration} - \text{samples lost to downtime}}{\text{total number of samples possible}} \times 100$$

Comparability - a measure of confidence with which one data set can be compared to another. Data comparability shall be achieved through the use of uniform procedures and U.S. EPA designated reference or equivalent methods.

For each of these attributes, acceptance criteria can be developed. Various parts of 40 CFR have identified acceptance criteria for some of these attributes as well as Guidance Document 2.122. In theory, if these MQOs are met, measurement uncertainty should be controlled to the levels required by the DQO. Tables 7.0.1, 7.0.2, and 7.0.3 list the MQOs for PM_{2.5} program. More detailed descriptions of these MQOs and how they will be used to control and assess measurement uncertainty will be described in Elements 14 and 23, as well as SOPs (Appendix B and Appendix E) of this QAPP.

Measurement Quality Objectives - Critical Criteria

Table 7.0.1 Critical Criteria Table

Criteria	Acceptable Range	# Samples Impacted	Frequency	CFR Reference	QA Guidance Doc Reference
Filter Holding Times					
Sample Recovery	4 days from sample end date	S	all filters	Part 50, App. L Sec 10.10	Sec. 8.2

Post-sampling Weighing	10 days at 25°C from sample end date	S	all filters	Part 50, App. L Sec 8.3	Sec. 7.11
Post-sampling Weighing	30 days at 4°C from sample end date	S	all filters	Part 50, App. L Sec 8.3	Sec. 7.11
Sampling Period	1380-1500 minutes	S	all filters	Part 50, App. L Sec 3.3	Sec. 8.2
Sampling Instrument		S			
Average Flow Rate	5% of 16.67 lpm	S	every 24 hours of op	Part 50, App.L Sec 7.4	Sec. 8.2
Individual Flow Rates	no flow excurs >5% for >5min	S	every 24 hours of op	Part 50, App.L Sec 7.4.3.1	
Variability in Flow Rate	CV < 2%	S	every 24 hours of op	Part 50, App.L Sec 7.4.3.2	
Filter					
Visual Defect Check	see reference	S	all filters	Part 50, App.L Sec 10.2	Sec 7.5
Filter Cond. Environment					
Equilibration	24 hours minimum	G	all filters	Part 50, App.L Sec 8.2	Sec. 7.6
Temp. Range	24-hr mean 20-23°C	G	all filters	Part 50, App.L Sec 8.2	Sec. 7.6
Temp.Control	+/- 2°C + SD over 24 hr	G	all filters	Part 50, App.L Sec 8.2	Sec. 7.6
Humidity Range	24-hr mean 30% - 40% RH	G	all filters	Part 50, App.L Sec 8.2	Sec. 7.6
Humidity Control	+/- 5% +SD over 24 hr	G	all filters	Part 50, App.L Sec 8.2	Sec. 7.6
Pre/post Sampling RH	Δ 24-hr means +/- 5% RH	S/G	all filters	Part 50, App.L Sec 8.3.3	
Balance	located in cond. environment	G	all filters	Part 50, App.L Sec 8.3.2	Sec. 7.2
Calibration & Verification					
One-point FR Check	+/- 4% of transfer standard	S 1/4 weeks		Part 50, App.L Sec 9.2.5	Sec 8.4

Measurement Quality Objectives - Operational Evaluations

Table 7.0.2 Operational Evaluations Table

Criteria	Acceptable Range	# Samples Impacted	Frequency	CFR Reference	QA Guidance Doc Reference
Filter Checks					
Lot Blanks	<15 ug change between weighing	G	3 filters per lot		Sec. 7.7
Exposure Lot Blanks	<15 ug change between weighing	G	3 filters per lot		Sec. 7.7
Filter Integrity (exposed)	no visual defects	S	each filter		Sec. 8.2
Filter Holding Times					
Pre-sampling	<30 days before sampling	S	all filters	Part 50, App.L Sec 8.3	Sec. 7.9

Detection Limit					
Lower DL	+/- 2 ug/m3	G	all filters	Part 50, App.L Sec 3.1	
Upper Conc. Limit	200 ug/m3	G	all filters	Part 50, App.L Sec 3.2	
Lab QC Checks					
Field Filter Blank	+/-30ug change between weighing	G	10% or 1 per weighing session	Part 50, App.L Sec 8.3	Sec. 7.7
Lab Filter Blank	+/-15ug change between weighing	G	10% or 1 per weighing session	Part 50, App.L Sec 8.3	Sec. 7.7
Balance Check	+/- 3 ug	G	beginning, every 10th sample, end		Sec. 7.9
Duplicate Filter Weighing	+/-15ug change between weighing		1 per weighing session		Sec 7.11
Sampler					
Filter Temp Sens	no excur >5°C for longer than 30 min	S	1/every 24 hours of op		Part 50, App.L Sec 7.4
Calibration & Verification					
External Leak Check	< 80 mL/min	G	1/ 5 sampling events	Part 50, App.L, Sec 7.4	Sec. 6.6 & 8.4
Internal Leak Check	< 80 mL/min	G	1/ 5 sampling events	Part 50, App.L, Sec 7.4	Sec. 6.6 & 8.4
Temperature Calibration	+/- 2°C of standard	G	if multi-point failure	Part 50, App.L, Sec 9.3	Sec. 6.4
Temp M-point Verification	+/- °C of standard	G	on installation, then 2/yr	Part 50, App.L, Sec 9.3	Sec. 6.7 & 8.2
One-point Temp Check	+/-4°C of standard	G	1/4 weeks	Part 50, App.L, Sec 9.3	Sec. 6.7 & 8.2
Pressure Calibration	+/- 10 mm Hg	G	on installation, then 2/yr	Part 50, App.L, Sec 9.3	Sec. 6.5
Pressure Verification	+/- 10 mm Hg	G	1/4 weeks	Part 50, App.L, Sec 9.3	Sec. 6.7 & 8.2
Monitor Calibrations	See R&P Manual		1/4 weeks		
Microbalance Calibration	Manufacturer's specifications	G	1/yr	Part 50, App. L, Sec. 8.1	Sec. 7.2
Lab Temperature	+/- 2°C	G	1/3 months		
Lab Humidity	+/- 2%	G	1/3 months		
Precision					
Collocated Samples	CV < 10%		every 6 days	Part 58, App.A, Sec 3.5 and 5.5	Sec. 10.2
Accuracy					
Temperature Audit	+/- 2°C	G	1/yr		Sec. 10.2
Pressure Audit	+/-10 mm Hg	G	1/yr		Sec. 10.2
Balance Audit	+/-0.050 mg	G	1/yr		Sec. 10.2
Flow Rate Audit	+/-4% of audit standard, +/-5% of design flow	G	1/yr	Part 58, App A, Sec 3.5	Sec. 10.1 & 10.2

	rate				
Calibration Standards	(working standards)				
Field Thermometer	+/-0.1°C resolution, +/- .5°C accuracy	G			Sec 4.2 & 6.4
Field Barometer	+/-1 mmHg resolution, +/- 5 mmHg accuracy	G	1/yr		Sec 4.2 & 6.5
Working Mass Stds.	0.025 mg	G	1/3 mo.		Sec 4.3 and 7.3
Calibration/ Verification					
Flow Rate Calibration	+/-2% of transfer standard	G	if multi-point failure	Part 50, App.L, Sec 9.2	Sec 6.3
Multi-point Verification	+/-2% of transfer standard	G	2/yr	Part 50, App.L, Sec 9.2	Sec 6.3 & 6.7
Design Flow Rate Adjust.	+/- 2% of design flow rate	G	at one-point or multi-point	Part 50, App.L, Sec 9.2.6	
Monitor Maintenance					
Impactor	cleaned/changed	G	every 5 sampling events		Sec 9.2
Inlet/downtube Cleaning	cleaned	G	every 15 sampling events		Sec 9.3
Filter Chamber Cleaning	cleaned	G	monthly		Sec 9.3
Leak Check	see Calibration & Verification	G			
Circulating Fan Filter Cleaning	cleaned/changed	G	monthly		Sec 9.3
Manufacturer-Recommended Maintenance	per R&P's SOP	G	per R&P's SOP		

Measurement Quality Objectives - Systematic Issues

Table 7.0.3 Systematic Issues

Criteria	Acceptable Range	# Samples Impacted	Frequency	CFR Reference	QA Guidance Doc Reference
Data Completeness	85%	G	quarterly	Part 50, App. N, Sec. 2.1	
Reporting Units	ug/m3 at ambient temp/pressure	G	all filters	Part 50.3	Sec. 11.1
Standards Recertifications					
Flow Rate Transfer Std.	+/-2% of NIST traceable Std.	G	4/yr	Part 50, App.L Sec 9.1 & 9.2	Sec. 6.3
Field Thermometer	+/-0.1°C resolution, +/-0.5°C accuracy	G	1/yr		Sec 4.2.2
Field Barometer	+/-1mm Hg resolution, +/-5mm Hg accuracy	G	1/yr		Sec 4.2.2
Primary Mass Stds.	0.025 mg	G	1/yr		Sec 4.3.7
Microbalance					
readability	1 ug	G	at purchase	Part 50, App.L Sec 8.1	Sec 4.3.6

Repeatability	1 ug	G	1/yr		Sec 4.3.6
Calibration & Check Standards				Part 50, App. L, Sec. 9.1	Sec. 6.3.2
Flow Rate Transfer Std.	+/-2% of NIST traceable Std.	G	1/yr	Part 50, App. L, Sec. 9.2	Sec. 6.3.3
Calibration/ Verification					
Clock/timer Verification	1 min/mo	G	1/4 weeks	Part 50, App.L, Sec 7.4	
Precision					
Single analyzer	CV+/- 10%	G	1/3 mo.	Part 50, App. A, Sec. 5.5	
FRM Performance Evaluation	+/-10%	G	25% of sites 4/yr	Part 58, App A, Sec 3.5	Sec 10.2

8.0 Special Training Requirements and Certification

Personnel assigned to the PM_{2.5} ambient air monitoring activities will meet the educational, work experience, responsibility, personal attributes, and training requirements for their positions. Records on personnel qualifications and training will be maintained in personnel files and will be accessible for review during audit activities. Adequate education and training are integral to any monitoring program that strives for reliable and comparable data. Training is aimed at increasing the effectiveness of the LCAQMD.

8.1 Ambient Air Monitoring Training

Appropriate training is available to employees supporting the Ambient Air Quality Monitoring Program, commensurate with their duties. Such training may consist of classroom lectures, workshops, forums, teleconferences, and on-the-job training.

The LCAQMD plans to train supervisors, management, field and laboratory staff by several means. Supervisors and management at the LCAQMD will hold and attend several U.S. EPA, ARB, and district meetings to keep informed about this new monitoring program as it develops.

On March 16 and 17, 1998, the ARB held a PM_{2.5} technical forum. Participants for the forum included the ARB, U.S. EPA, Office of Environmental Health Hazard Assessment, Bay Area Air Quality Management District (AQMD), South Coast AQMD, San Joaquin Valley Unified Air Pollution Control District, several stakeholders, and expert panelists from industry and several colleges and universities. The forum included presentations on air quality history, network planning, agency needs, stakeholders comments, and discussions on health studies, public notification and forecasting, special studies versus standing air monitoring networks, data analysis, and modeling and emission inventory assessment. A summary of the forum can be found on the ARB's web page at www.arb.ca.gov/pm25/tecforum/tecforum.htm.

Monitoring and laboratory staff training for the PM_{2.5} program will be conducted by two means. First, training was being coordinated with WESTAR, and during August 1998, training for all field and laboratory personnel was conducted. The two-day workshop provided hands-on experience for state and local field and laboratory staff. The first day focused on field operations and included: an update from U.S. EPA, presentations by experienced PM_{2.5} FRM operators, hands-on training, and an open question-and-answer session with a panel of field experts. The second day focused on laboratory operations and included: presentations by laboratory experts; balance room set-up overview; break-out

groups for hands-on experience with the PM_{2.5} FRM monitors, weighing room operations, PM_{2.5} data reporting to ahrs, and an open question-and-answer session with a panel of laboratory experts.

Staff are required to read and understand U.S. EPA QA Guidance Document 2.12, "Monitoring PM_{2.5} in ambient air using designated reference or Class I equivalent methods," 1998, and read and understand the District's PM_{2.5} QAPP. Staff may also participate in the U.S. EPA's Air Pollution Training Institute (APTI) courses covering PM_{2.5} air monitoring. Staff may attend the APTI telecourses and view the training video tapes developed as a supplement to the courses. Below is a list of APTI courses thus far:

- Network Design and Site Selection for Monitoring PM_{2.5} and PM₁₀ in Ambient Air
- PM_{2.5} Monitoring Methods
- PM_{2.5} Monitoring QA/QC

In addition, staff may participate in U.S. EPA and AWMA sponsored training courses. Below is a list of U.S. EPA/AWMA training thus far:

- Air-303 National PM_{2.5} Speciation Laboratory Program
- Air-304 the PM_{2.5} Quality Assurance Program
- PM_{2.5} Laboratory and Sampling Equipment

District staff will attend PM_{2.5} ambient air monitoring training courses, workshops, forums, etc., on an as needed basis. In addition, training from the ARB staff on laboratory and sampler operations can be obtained as it is offered or needed.

8.2 Certification

There is currently no District plan on establishing a certification program for site operators and laboratory personnel. Certification of site operators and laboratory personnel will be provided through U.S. EPA-provided and sponsored certification programs.

9.0 Documentation and Records

The following information describes the LCAQMD document and records procedures for the PM_{2.5} Program. In U.S. EPA's QAPP regulation and guidance, U.S. EPA uses the term reporting package. Reporting package is defined as all the information required to support the concentration data reported to U.S. EPA, which includes all data required to be collected as well as data deemed important by the District under its policies and records management procedures. Table 9.0.1 identifies these documents and records.

9.1 Information Included in the Reporting Package

9.1.1 Routine Data Activities

The LCAQMD has a structured records management retrieval system that allows for the efficient archive and retrieval of records. The PM_{2.5} information will be included in this system. Table 9.0.1 includes the documents and records that will be filed according to the statute of limitations discussed in Element 9.3.

Table 9.0.1 PM_{2.5} Reporting Package Information

Categories	Record/Document Types
Management and Organization	State Implementation Plan, Reporting agency information, Organizational structure, Personnel qualifications and training, Quality management plan, Document control plan, U.S. EPA Directive Grant allocations, and Support Contract
Site Information	Network description, Site characterization file, Site maps, and Site Pictures,
Environmental Data	QA Project Plans, Standard operating procedures (SOPs), Field and laboratory notebooks, Sample

Operations	handling/custody records, Inspection/Maintenance records, and Control Charts
Raw Data	All original data (routine and QC data) including data entry forms
Data Reporting	Air quality index report, Annual SLAMS air quality information, Data/summary reports, and Quarterly QC reports
Data Management	Data algorithms, Data management plans/flowcharts, PM2.5 Data, Data Management Systems, and Quarterly QC reports
Quality Assurance	Network reviews, Control charts, Data quality assessments, QA reports, System audits, Response/Corrective action reports, and Performance Audits

9.1.2 Annual Summary Reports Submitted to U.S. EPA

As indicated in 40 CFR Part 58, an annual summary report of all the ambient air quality monitoring data from all monitoring stations designated as SLAMS shall submitted to the U.S. EPA Administrator, through the Region IX Office. The report will be submitted by July 1 of each year for the data collected from January 1 to December 31 of the previous year. The report will contain the following information:

PM-fine (PM2.5)

Site and Monitoring Information.

- City name (when applicable)
- county name and street address of site location
- AIRS-AQS site code
- AIRS-AQS monitoring method code

Summary Data

- Annual arithmetic mean ($\mu\text{g}/\text{m}^3$) as specified in 40 CFR part 50, Appendix N (Annual arithmetic mean NAAQS is $15\mu\text{g}/\text{m}^3$)
- All daily PM-fine values above the level of the 24-hour PM-fine NAAQS ($65\mu\text{g}/\text{m}^3$) and the dates of occurrence.
- Sampling schedule used as once every 6 days, every day, etc.
- Number of 24-hour average concentrations in the ranges listed below:

Table 9.0.2 PM2.5 Summary Report Ranges

Range	Number of Values
0 to 15 ($\mu\text{g}/\text{m}^3$)	
16 to 30	
31 to 50	
51 to 70	
71 to 90	
91 to 110	
greater than 110	

Management will certify that the annual summary is accurate to the best of their knowledge. This certification will be based on the various assessments and reports performed by the organization, in particular, the Annual QA Report discussed in Element 21 that documents the quality of the PM2.5 data and the effectiveness of the quality system.

9.2 Data Reporting Package Format and Documentation Control

Table 9.0.1 represents the documents and records, at a minimum, that must be filed into the reporting package. The details of these various documents and records will be discussed in the appropriate elements of this document.

All raw data required for the calculation of a PM2.5 concentration, the submission to the AIRS database, and QA/QC data, are collected electronically or on data forms that are included in the field and

analytical methods Elements. All hardcopy information will be filled out in indelible ink. Corrections will be made by inserting one line through the incorrect entry, initialing this correction, and placing the correct entry alongside the incorrect entry, if this can be accomplished legibly, or by providing the information on a new line.

9.2.1 Notebooks

The LCAQMD will issue notebooks to each field and laboratory technician. The notebooks will be associated with the individual and the PM2.5 Program. Although data entry forms are associated with all routine environmental data operations, the notebooks can be used to record additional information about these operations.

Field Notebooks - Notebooks will be issued for each sampling site. The notebooks will contain the appropriate data forms for routine operations as well as inspection and maintenance forms and SOPs.

Lab Notebooks - Notebooks will also be issued for the laboratory. These notebooks will be associated with the PM2.5 Program. One notebook will be available for general comments/notes; others will be associated with, the temperature and humidity recording instruments, the freezer, calibration equipment/standards, and the analytical balances used for this program.

Sample Shipping / Receipt - If shipping and receiving is implemented, the laboratory will package samples for shipping and will receive samples directly. Lab notebooks will be utilized for sample shipping and receiving information and data will be entered into the Laboratory Information Management System.

9.2.2 Electronic Data Collection

It is anticipated that certain instruments will provide an automated means for collecting information that would otherwise be recorded on data entry forms. Information on these systems are detailed in Elements 18 and 19. In order to reduce the potential for data entry errors, automated systems will be utilized where appropriate and will record the same information that is found on data entry forms.

The LCAQMD downloads the Filter and Interval Data from the R&P sampler using the Palm Vx and text manipulation software. The data are electronically uploaded into the District's monitoring database and the interval data is archived for future reference if needed. Details on the procedure are provided in the District's SOP, Appendix D found towards the end of this document.

9.3 Data Reporting Package Archiving and Retrieval

As stated in 40 CFR part 31.42, in general, all the information listed in Table 9.0.1 will be retained for three years from the date the grantee submits its final expenditure report unless otherwise noted in the funding agreement. However, if any litigation, claim, negotiation, audit or other action involving the records has been started before the expiration of the three-year period, the records will be retained until completion of the action and resolution of all issues which arise from it, or until the end of the regular three-year period, whichever is later. The ARB will extend this regulation in order to store records for three full years past the year of collection. For example, any data collected in calendar year 1999 (1/1/99 - 12/31/99) will be retained until, at a minimum, January 1, 2003, unless the information is used for litigation purposes.

10.0 Sampling Design

Complete details for this Element of the QAPP can be found in the "1998 California Particulate Matter Monitoring Network Description" which was submitted to U.S. EPA Region IX in June 1998. It can

also be found on the ARB's web page at <http://arbis.ca.gov/aqd/pm25/pmfdsign.htm>. Below is background information on the 1998 California Particulate Matter Monitoring Network Description. Elements 10.1, 10.2, 10.3, and 10.4 provide additional information.

The goal of the PM_{2.5} monitoring program is to provide ambient data that support the nation's air quality programs. These data include aerosol mass measurements and chemically resolved, or speciated data. Mass measurements are used principally for PM_{2.5} national ambient air quality standards (NAAQS) comparison purposes in identifying areas that meet or do not meet the PM_{2.5} NAAQS and in supporting area designations as attainment or non-attainment. Chemically resolved data serve the implementation needs associated with developing emission mitigation approaches to reduce ambient aerosol levels. These needs include emissions inventory and air quality model evaluation, source attribution analysis, and tracking the success of emission control programs.

The LCAQMD, in partnership with the California ARB and other local air quality management districts within California, has developed a PM_{2.5} monitoring network to implement the new PM_{2.5} NAAQS. The term PM_{2.5} applies to airborne particles with aerodynamic diameter less than 2.5 microns. The PM_{2.5} network is designed to enable the air quality management community in California to collect ambient PM_{2.5} data as required by Title 40 of the Code of Federal Regulations (40 CFR), Parts 50, 53, and 58, published in the Federal Register on July 18, 1997. The ambient data from this network will be used for designating areas as attainment or non-attainment for the PM_{2.5} air quality health standards, developing control programs, and tracking the progress of these control programs.

During the early stages of the PM_{2.5} network design process, local air quality management districts and the ARB established monitoring planning areas (MPA) for the State. There are 18 MPAs that have been used for locating PM_{2.5} monitoring sites throughout California. They are determined to be the best geographical divisions for the PM_{2.5} monitoring network planning. They are not intended for designating areas as attainment or non-attainment or for determining specific PM_{2.5} control measures. The boundaries to be used for these purposes will not be established until adequate PM_{2.5} data are available. The local air quality management districts and the ARB will recommend appropriate non attainment boundaries to the U.S. EPA.

The "1998 California Particulate Matter Monitoring Network Description" consists of a statewide summary and 17 appendices. Each appendix includes a detailed description of the proposed network for each designated MPA in the State, except that the network description for the Coachella Valley MPA is included with the network description for the South Coast MPA. The objective of this document is to summarize the particulate matter monitoring strategy for California.

Element 10.1, below, describes the District's rationale for the design of collocated samplers.

10.1 Rationale for the Design of Collocated Samplers

In order to estimate the precision and bias of the various PM_{2.5} samplers, the U.S. EPA requires that for each method designation at least 25% of the PM_{2.5} sites must be collocated. In 1998, the ARB and the local air quality agencies in California plan to deploy 16 monitoring sites operating PM_{2.5} single channel samplers and 62 monitoring sites operating PM_{2.5} sequential samplers (Table 10.0.1). To satisfy the minimum requirement for collocated samplers in California, four sites will operate collocated single channel samplers and 16 sites will operate collocated sequential samplers.

Table 10.0.1 Summary of PM_{2.5} Samplers to be Deployed in California in 2001

Sampling Method Designation	Number of Samplers		
	Primary	Collocated	Total
Single Channel	15	4	19
Sequential	67	17	84
Total	82	21	103

The local air quality management districts in California selected collocated PM_{2.5} sites based on the following criteria listed in order of importance:

- Measured or estimated PM_{2.5} concentrations - monitoring sites with high measured PM_{2.5} concentrations or high estimated PM_{2.5} concentrations based on PM₁₀ data were selected to operate collocated samplers.
- Operating agency - agencies operating more than four PM_{2.5} monitoring sites will have about 25% of their PM_{2.5} sites collocated. Agencies operating less than four monitoring sites were geographically grouped together and a high site was selected to represent a group.
- Geographical representation - we tried to ensure geographical representation throughout California because varying meteorological and air quality conditions may influence the precision and bias of various PM_{2.5} samplers.
- Practical considerations - the monitoring sites selected to operate collocated PM_{2.5} samplers had to have enough platform room to maintain 1-4 meter spacing between primary and collocated sampler and adequate power available.

Each collocated sampler must be operated concurrently with its associated primary sampler. The one-in-six day sampling schedule was selected for collocated samplers so that the sampling days are distributed evenly over the year and over the seven days of the week.

The adequacy of the quality assurance PM_{2.5} network will be reviewed during annual network reviews and, if needed, additional collocated sites will be selected.

10.2 Design Assumptions

The sampling design is based on the assumption that following the rules and guidance provided in CFR and guidance for network design and optimum site exposure for PM_{2.5} and PM₁₀ will result in data that can be used to measure compliance with the national standards. The local air quality management districts established 18 MPAs as the administrative framework for planning a PM_{2.5} monitoring network. With few exceptions, the boundaries of MPAs correspond to the boundaries of the various air basins in the State. California is divided geographically into air basins for the purpose of managing the air quality resources on a regional basis. Areas within each air basin are considered to share the same air masses and are therefore expected to have similar ambient air quality. The State is currently divided into 15 air basins.

The State is also divided into air pollution control districts and air quality management districts, which are county or regional governing authorities that have primary responsibility for controlling air pollution from stationary sources. In the South Central Coast Air Basin and the Salton Sea Air Basin, the MPAs correspond to the local district boundaries of the agencies having jurisdictions over these areas. The splitting of these air basins facilitates the development of the PM_{2.5} network plans within these MPAs. The South Central Coast Air Basin has been divided into three MPAs, one for each of the districts in the air basin. The Salton Sea Air Basin has been divided into two MPAs, Coachella Valley MPA, which is under the jurisdiction of the South Coast AQMD, and the Imperial County MPA, which is under the jurisdiction of the Imperial County APCD.

10.3 Siting PM_{2.5} samplers

The following is a list of the network design objectives that were given the highest priority during the PM_{2.5} network design:

- Satisfy the U.S. EPA core monitoring requirements
- Represent California air basins and provide geographical representation
- Represent high concentrations in populated areas
- Characterize emission sources in high concentration areas
- Consider the needs of ongoing special health studies for particle measurements

The LCAQMD analyzed all available information to develop a list of sites that would best satisfy these objectives for lake County. Preference was given to adapting existing sites to PM_{2.5} monitoring. During the site selection process, the District considered the following factors:

- Population statistics
- Land use characteristics
- Climate
- Suspected area emission sources (e.g., wood smoke, agricultural burning, etc.)
- Existing monitoring network
- Existing particulate matter data, including dichot and pm10 data
- Potential transport corridors
- Ongoing special health studies

Lakeport was decided as the most representative site for the Lake County Air Basin. The PM_{2.5} monitoring network planned for other sites in California consists of the following:

- Eighty-nine core PM_{2.5} state and local air monitoring stations (SLAMS). All core sites will collect data to determine attainment status with regard to both of the new PM_{2.5} standards. In addition, many of these sites will satisfy other monitoring objectives, including transport assessment and assistance in health studies
- Two background sites to measure the lowest ambient PM_{2.5} concentrations representative of California
- One special purpose transport assessment site primarily operated to determine the impact of transported PM_{2.5} on ambient concentrations in the receptor area
- Thirteen improve sites to assess visibility impairment in Class I areas. Not all of the existing improve sites will be integrated with the PM_{2.5} program and some new sites will be established over the next two years in an effort to integrate visibility assessment with the PM_{2.5} monitoring. The improve protocol at these sites will be changed to make it more compatible with the national PM_{2.5} program

10.4 Core PM_{2.5} State and Local Air Monitoring Stations

The proposed PM_{2.5} monitoring network includes 89 PM_{2.5} monitoring sites to collect data for comparison to the NAAQS. These sites are situated to meet the requirements for core PM_{2.5} monitoring sites (core sites). Based on U.S.EPA regulations, core sites should include:

- A population-oriented site with the highest expected PM_{2.5} concentrations
- A site in an area of high population density with poor air quality (not necessarily located in an area of expected maximum concentrations)
- A site collocated at a PAMS site, for each PAMS area included in the MPA

The core sites are the most important sites in the PM_{2.5} network. Each core site will operate FRM samplers purchased through the national PM_{2.5} procurement contract established by the U.S.EPA. Only data from core sites are eligible for comparison to both the annual and 24-hour PM_{2.5} NAAQS. All of the sites proposed for 1998 have a population-oriented location and neighborhood zone of representation. The neighborhood zone of representation means that the 24-hour concentrations should vary by no more than ± 10 percent over an area whose diameter is between 0.5 and 4 kilometers.

All core sites selected to operate PM_{2.5} FRM samplers are located in populated areas with expected high PM_{2.5} concentrations for the broader area they represent. Some core sites will provide useful information about PM_{2.5} transport and emission sources. Each of the California air basins will have at least one PM_{2.5} monitoring site. Air basins with high population and expected high PM_{2.5} concentrations will have additional monitoring sites to provide better geographical representation.

11.0 Sampling Methods Requirements

11.1 Purpose/Background

This method provides for measurement of the mass concentration of fine particulate matter having an aerodynamic diameter less than or equal to a nominal 2.5 micrometers (PM_{2.5}) in ambient air over a 24-hour period for purposes of determining whether the primary and secondary national ambient air quality standards (NAAQS) for particulate matter specified in 40 CFR Part 50.7 are met. The measurement process is considered to be non-destructive, and the PM_{2.5} sample obtained can be subjected to subsequent physical or chemical analyses.

11.2 Sample Collection and Preparation

FRM samplers will be used as the monitor for collection of PM_{2.5} samples for comparison to the NAAQS. In the District, the Rupprecht & Patashnick (R&P) Model 2000 sampler is employed. The sampler is a single-day sampler that meets FRM designation. The sampler has been installed with adherence to procedures, guidance, and requirements detailed in 40 CFR Parts 50, 53 and 58, U.S. EPA QA Guidance Document, the sampler manufacturers operation manual, District Field SOPs, and this QAPP.

11.2.1 Sample Set-up

The FRM sampler is run at a sample frequency of one-in-six days. Detailed sample set-up procedures are available from the District's PM_{2.5} sample methods standard operating procedure, Appendix E.

11.2.2 Sample Recovery

Sample recovery of any individual filter from the FRM sampler must occur within 96 hours of the end of the sample period for that filter. This will normally be the day after a sample is taken. The next sample would also be set-up at this time. Sample recovery procedures are detailed in the District's PM_{2.5} sampling methods standard operating procedure, Appendix E.

11.3 Support Facilities for Sampling Methods

The following Table lists the supplies that are available to PM_{2.5} field operator. Support facilities for PM_{2.5} sampling include offices, and laboratory. Not all of these items are needed on every site visit, but are available at all times.

Table 11.0.1 Support Facility Supplies

<u>Item</u>	<u>Quantity</u>	<u>Notes</u>
Powder Free Gloves	box	Material must be inert and static resistant
Fuses	2	Of the type specified in the sampler manual

R&P Operations Manual	1	
PM2.5 Sampling SOP	1	
Flow rate verification filter	1	Contained in sampling cassette
Calibration Kit	1	Gilian, Assman, tools, forms
Impactor Service Kit	1	Replacement filters and oil
Kim-Wipes	1 Box	Dust resistant
Laptop and Cable	1	To experiment with the Palm V
Tools	1 box	screw drivers, fitted wrenches, etc.
WINS Impactor Assembly	1	Extra used during an exchange
FRM Filter Cassettes	1	With pre-weighed filter, or field blanks
Transport Container	2	1 for pre-weighed, 1 for sampled filter.

11.4 Sampling/Measurement System Corrective Action

Corrective action measures in the PM2.5 Air Quality Monitoring Network will be taken to ensure the data quality objectives are attained. There is the potential for many types of sampling and measurement system corrective actions. Table 11.0.2 is an attempt to detail the expected problems and corrective actions needed for a well-run PM2.5 network.

Table 11.0.2 Field Corrective Action

<u>Item</u>	<u>Problem</u>	<u>Action</u>
Filter Inspection (sample)	Pinhole(s) or torn	1) If additional filters have been brought, use one (Pre-of them. Void filter with pinhole or tear. 2) Use new field blank filter as sample filter. 3) Obtain a new filter from lab. 4) Document on field data sheet.
Filter Inspection (Post sample)	Pinhole(s) or torn	1) Inspect area downstream of filter in sampler and determine if particulate has been by-passing filter. 2) Inspect in-line filter before sample pump for excessive loading. Replace as necessary. 3) Document on field data sheet.
WINS Impactor	Heavily loaded	1) Clean down-tube and service WINS impactor.
Flow Rate	Out of Spec	1) Repeat flow rate check. 2) Perform leak test. 3) Check flow rate at 3 points (15.0,16.7,18.3 lpm) to see if the problem is with zero bias or slope. 4) Re-calibrate flow rate. 5) Document on the calibration and data sheet.
Leak Test	Leaks! (<80 mL/min)	1) Repeat leak test. 2) Inspect all seals and O-rings, replace as necessary and repeat leak test. 3) Document in log book. 4) flag data since last successful leak test.

Sample Flow Rate	Low flows	<ol style="list-style-type: none"> 1) Check programming of sampler flow rate. 2) Check actual flow with the Gilian. 2) Inspect downstream in-line filter, replace as necessary. 4) Document in calibration sheet, log book.
Temperature(s) (Ambient/Filter)	Out of Spec (+/- 4°C)	<ol style="list-style-type: none"> 1) Check with a different NIST traceable thermometer. 2) Check at a different temperature. 3) Repeat ambient temperature verification. 4) Connect new thermocouple. 5) Document on the calibration/data sheet.
Ambient Pressure	Out of Spec (≈10 mm Hg)	<ol style="list-style-type: none"> 1) Repeat ambient pressure verification. 2) Check second pressure source. Pressure correction may be required. 3) Connect new pressure sensor. 4) Document on calibration/data sheet.
E.T.	Out of Spec	<ol style="list-style-type: none"> 1) Check Programming, 2) Verify Power Outages
	Sample did not run	<ol style="list-style-type: none"> 1) Check Programming 2) Program sample run to start while at site (use a flow verification filter). 3) Document on data sheet.
Power	Interruptions LCD panel on, (but sample not working)	<ol style="list-style-type: none"> 1) Check Line Voltage 1) Check circuit breaker, some samplers have battery back-up for data but will not work without AC power. 2) Document in log book
Data Downloading	Data will not xfer.	<ol style="list-style-type: none"> 1) Document key information on sample data sheet. 2) Resolve problem before data is written over in sampler microprocessor. 3) Notify Field Manager.

11.5 Sampling Equipment, Preservation, and Holding Time Requirements

This element details the requirements needed to prevent sample contamination, the volume of air to be sampled, temperature preservation requirements, and the permissible holding times to ensure against degradation of sample integrity.

11.5.1 Sample Contamination Prevention

The PM_{2.5} network has rigid requirements for preventing sample contamination. Powder free gloves

are worn while handling filter cassettes. Once the filter cassette is taken outside of the weigh room it must never be opened as damage may result to the 46.2 mm Teflon filter. Filter cassettes are to be stored in filter cassette storage containers as provided by the sampler manufacturer during transport to and from the laboratory. Once samples have been weighed, they are to be stored with the particulate side up and individually stored in static resistant petri dishes and sealing zip lock bags.

11.5.2 Sample Volume

The volume of air to be sampled is specified in 40 CFR Part 50. Sample flow rate of air is 16.67 liters per minute (LPM). The total sample of air collected will be 24 cubic meters based upon a 24-hour sample. Samples are expected to be 24 hours; however, in some cases a shorter sample period may be necessary, not to be less than 23 hours. Since capture of the fine particulate is predicated upon a design flow rate of 16.67 LPM, deviations of greater than 10% from the design flow rate will enable a shut-off mechanism for the sampler. If a sample period is less than 23 hours or greater than 25 hours, the sample will be flagged.

11.5.3 Temperature Preservation Requirements

The temperature requirements of the PM_{2.5} network are explicitly detailed in 40 CFR Part 50, Appendix L1. During transport from the weigh room to the sample location, there are no specific requirements for temperature control; however, the filters will be located in their protective container and in the transport container. Excessive heat must be avoided (e.g., do not leave in direct sunlight or a closed-up car during summer). The filter temperature requirements are detailed in Table 11.0.3.

Table 11.0.5 Filter Temperature Requirements

<u>Item</u>	<u>Temperature Requirement</u>	<u>Reference</u>
During sampling until recovery	< 5°C above ambient	40 CFR Part 50, Appendix L, and Element 7.4.10
From time of recovery to start of conditioning	< 25°C	40 CFR Part 50, Appendix L, Element 10.13
Post sample transport	< 25°C (weighed within 10 days) < 4°C (weighed within 30 days)	40 CFR Part 50, Appendix L Element 8.3.6

11.5.4 Permissible Holding Times

The permissible holding times for the PM_{2.5} sample are clearly detailed in both 40 CFR Part 50, Appendix L, and the U.S. EPA QA Guidance Document 2.12. These holding times are provided in Table 11.0.6 below.

Table 11.0.6 Holding Times

<u>Item</u>	<u>Holding Time</u>	<u>From:</u>	<u>To:</u>	<u>Appx L Element</u>
Pre-weighed Filter	<30 days	Pre-weigh Date	Date of Sample	8.3.5

Recovery of Filter	<96 hours	Completion of sample period	Time of sample recovery	10.10
Transport of Filter	<24 Hours (ideally)	Time of recovery	Time placed in conditioning room	10.13
Post sample (<4°C)	<30 days	Sample end date/time	Date of Post Weigh	8.3.6
(<25°C)	<10 days	Sample end date/time	Date of Post Weigh	8.3.6

References

The following documents were utilized in the development of this Element:

U.S. EPA (1997a) National Ambient Air Quality Standards for Particulate Matter - Final Rule. 40 CFR Part 50. Federal Register, 62(138):38651-38760. July 18,1997.

U.S. EPA (1997b) Revised Requirements for Designation of Reference and Equivalent Methods for PM_{2.5} and Ambient Air Quality Surveillance for Particulate Matter-Final Rule. 40 CFR Parts 53 and 58. Federal Register, 62(138):38763-38854; July 18, 1997.

U.S. EPA Quality Assurance Guidance Document 2.12: Monitoring PM_{2.5} in Ambient Air Using Designated Reference or Class I Equivalent Methods; March 1998.

12.0 Sample Custody

12.01 Purpose/Background

Due to the potential use of the PM_{2.5} data for comparison to the NAAQS and the requirement for extreme care in handling the sample collection filters, sample custody procedures will be followed. Figures 12.0.1 and 12.0.2 represent chain of custody forms that will be used to track the stages of filter handling throughout the data collection operation. Although entries on this form will be made by hand, the information will be entered into the sample tracking system, where an electronic record will be kept (see Element 19). This Element addresses sample custody procedures at the following stages: Pre-sampling; Post-sampling; Filter receipt; and Filter archive

Table 12.0.1 Parameter List

Parameter	Frequency	Comment
<i>Pre-Sampling</i>		
Site Operator Initial	Every sample	Initials of the site operator setting up the sampling run.
Filter ID	Every sample	Unique filter ID of filter given by the weighing laboratory.
Container ID	Every Sample	Actual site name is printed on the cassettes.
Receipt Date From Lab	Every sample	Date filter taken by the site operator from storage to the field.
Sampler ID	Every sample	Sampler serial number associated with

		the model number.
Installation Date/Time	Every sample	Date/Time filter was placed into sampler by the site operator.
Pre-Sampling Comments	When required	Comments from site operator during pre-sampling filter selection.
<i>Post-Sampling</i>		
Site Operator Final	Every sample	Initials of the site operator completing the sampling run.
Removal Date/Time		Date/Time filter taken by the site operator from the monitor for transport from the field.
Temp.	Every sample	Temp at which sample is deposited in transport container.
Comments	As needed	If integrity is questioned, or sampler operation is questioned.
<i>Balance Room Receipt</i>		
Date/Time Received		Date/Time filter received at the Lab
Temp.	Every Sample	Temp when received.
<i>Filter Archive</i>		
Date/Archived		Immediately after post-weight (Date of post weight)

12.1 Sample Custody Procedure

One of the most important values in the sample custody procedure is the unique filter ID number, illustrated in Figure 12.0.3. The filter ID is an alpha-numeric value. The first set of digits represent a unique number for the filter run. The filter ID is utilized from the unique number imprinted on the filter or generated by the laboratory analyst at the time of pre-weighing.

Filter ID example: 3192

12.1.1 Pre-Sampling Custody

The LCAQMD laboratory SOP (Appendix B) defines how the filters will be enumerated, conditioned, weighed, placed into the protective shipping container, sealed with tape, and distributed to the site operators. Filters must be used within 30 days of pre-sampling weighing.

12.1.2 Post Sampling Custody

The field sampling SOP specifies the technique for properly collecting and handling the sample filters. Upon visiting the site:

- Select the appropriate Filter Chain of Custody Record.
- Remove filter cassette from the sampler. Briefly examine it to determine appropriate filter integrity flag and seal the filter with the snap on filter cap and enclosure.
- Place the protected filter into the shipping/transport container with the appropriate temperature control devices. After electronic download of the sampler, the Post Sampling Filter Recovery Information is

recorded on the Filter Chain of Custody Record.

12.1.3 Filter Receipt

When samples are transported to the laboratory by the site operator, they are delivered directly to the PM2.5 weighing laboratory with the associated filter chain of custody record(s).

Once the PM2.5 weighing laboratory receives the filter, the samples are logged in and prepared for conditioning and post-sampling weighing activities. These activities are included in the analytical SOP. The balance room technician will take the filters from the protective containers and the cassettes and examine them for integrity, and noted on the data entry sheets. The samples will be conditioned in the PM2.5 weighing laboratory.

12.1.4 Filter Archive

Upon completion of post-sampling weighing activities, each filter will be packaged according to the SOP and stored (uniquely identified by Site ID and Run date) in the District's PM 2.5 freezer. Samples will be archived in the laboratory freezer for one year past the date of collection. Prior to disposal, U.S. EPA Region IX will be notified of the District's intent to dispose of the filters.

13.0 Analytical Methods Requirements

13.1 Purpose/Background

This method provides for gravimetric analyses of filters used in the District's PM2.5 network. The net weight of a sample is calculated by subtracting the initial weight from the final weight. Once calculated, the net weight can be used with the total volume sampled through a filter to calculate the ambient concentration for comparison to the daily and annual NAAQS. Since the method is non-destructive, and due to possible interest in sample composition, the filters will be archived after final gravimetric analyses has occurred.

13.2 Preparation of Samples

Upon delivery of approved 47 mm Teflon filters for use in the network, the receipt is documented and the filters stored in the conditioning/weighing room/laboratory. Storing filters in the laboratory makes it easier to maximize the amount of time available for conditioning. Upon receipt, cases of filters will be logged with the date of receipt, opened one at a time and used completely before opening another case. All filters in a lot will be used before a case containing another lot is opened. When more than one case is available to open, the First In - First Out rule will apply. This means that the first case of filters received is the first case that will be used.

Filters will be taken out of the case when there is enough room for more samples in the pre-sampling weighing section of the filter conditioning storage compartment. Filters will be visually inspected according to the FRM criteria to determine compliance. See the inspection procedure for new shipments of filters. Filters will then be stored in the filter conditioning compartment for a minimum period of 24 hours. Filters will not be left out for excessive periods of conditioning since some settling of dust is possible on the filter top sides.

13.3 Analysis Method

13.3.1 Analytical Equipment and Method

The analytical instrument used for gravimetric analysis in the FRM or equivalent PM_{2.5} sampler method (gravimetric analysis) is the microbalance. The District will use a Cahn which has a readability of 1 ug and a repeatability of 1 microgram (ug). The microbalance is calibrated yearly by a balance technician from Sartorius Quality Control Services.

The gravimetric analysis method consists of information needed to establish and verify the continued acceptability of the set of primary and secondary mass reference standards, and a new lot of filters, and to establish stable conditions in the weighing room. The three main subparts cover presampling filter weighing (tare weight); postsampling documentation and inspection; and postsampling filter weighing (gross weight). The details of the gravimetric analysis method can be found in the District's microbalance standard operating procedure.

13.3.2 Conditioning and Weighing Room

The primary support facility for the PM_{2.5} network is the filter conditioning and weighing room/laboratory. Additional facility space is dedicated for long term archiving of the filter. This weighing room/laboratory is used for both presampling and postsampling weighing of each PM_{2.5} filter sample. Specific requirements for environmental control of the conditioning/weighing room laboratory are detailed in 40 CFR Part 50 Appendix L1

13.3.3 Environmental Control

The District's weighing room facility is an environmentally controlled room with temperature and humidity control. Temperature is controlled within the range of 20 to 23° C. Humidity is controlled between 30 and 40%. Temperature and relative humidity are measured and recorded continuously during equilibration. The balance is located on a vibration free table and is protected from or located out of the path of any sources of drafts. Filters are conditioned before both the pre- and post-sampling weighings. Filters are be conditioned for at least 24 hours to allow their weights to stabilize before being weighed.

13.4 Internal QC and Corrective Action for Measurement System

A QC notebook or database (with disk backups) containing QC data will be maintained, and include microbalance calibration and maintenance information, routine internal QC checks of mass reference standards and laboratory and field filter blanks, and external QA audits. These data will duplicate data recorded on laboratory data forms but will consolidate them so that long-term trends can be identified. QC charts may be maintained on each microbalance and included in this notebook. These charts may allow the discovery of excess drift that could signal an instrument malfunction.

At the beginning of each weighing session, after the analyst has completed zeroing and calibrating the microbalance and measuring the working standard, three laboratory filter blanks established for the current filter lot are weighed. Filter blanks from the most recently completed field blank study are also

weighed. After approximately every tenth filter weighing, the analyst will reweigh one working standard. The microbalance is zeroed as necessary between each weighing. The working standard and blank measurements are recorded in the laboratory QC notebook or database. If the working standard measurements differ from the certified values or the pre-sampling values by more than 3 ug, the working standard measurements will be repeated. If the blank measurements differ from the presampling values by more than 15 ug, the blank measurements will be repeated. If the two measurements still disagree, the Laboratory Manager will be contacted, who may direct the analyst to (1) reweigh some or all of the previously weighed filters, (2) recertify the working standard against the laboratory primary standard, (3) conduct minor, non-invasive diagnostic and troubleshooting, and/or (4) arrange to have the original vendor or an independent, authorized service technician troubleshoot or repair the microbalance.

Corrective action measures in the PM2.5 FRM system will be taken to ensure good quality data. There exists the potential for many types of sampling and measurement system corrective actions. Tables 13.0.1 (organized by laboratory support equipment) and 13.0.2 (organized by laboratory support activity) list potential problems and corrective actions needed to support a well run PM2.5 network. Filter weighing will be delayed until corrective actions are satisfactorily implemented.

Table 13.0.1 Potential Problems/Corrective Action for Laboratory Support Equipment

System	Item	Problem	Action	Notification
Weigh Room	Humidity	Out of Specification	Check HVAC system	Lab Manager
Weigh Room	Temperature	Out of Specification	Check HVAC system	Lab Manager
Balance	Internal Calibration	Unstable	Redo and check working standard	Lab Manager
Balance	Zero	Unstable	Redo and check for drafts, guard	Lab Manager
Balance	Working Standards	Out of Specification	Check with Primary standards	Lab Manager
Balance	Filter Weighing	Unstable	Check Lab Blank Filters	Doc. in Log Book

Table 13.0.2 Filter Preparation and Analysis Checks

Activity	Method and frequency	Requirements - Action if the requirements are not met
Microbalance Use	Resolution of 1 ug, repeatability of 1 ug	Obtain proper microbalance
Control of balance environment	Climate-controlled, draft-free room or chamber or equivalent	Modify the environment
Use of Mass reference standard	Working standards checked every 3 to 6 months against laboratory primary standards. Standards up to 200 mg*, individual standard's tolerance less than 25 ug handle with smooth, nonmetallic forceps	Obtain proper standards or forceps
Filter handling	Observe handling procedure	Use powder-free gloves and smooth forceps. Replace 210Po antistatic strips every 6 months. Discard mishandled filter or old antistatic strip
Filter integrity check	Visually inspect each filter	No pinholes, separation, chaff, loose material, discoloration, or filter non-uniformity. Discard defective filter
Filter identification	Filter ID on filter	Assign Filter Number.
Presampling filter equilibration	Determine the correct equilibration conditions and period (at least 24 hours) for each new lot of filters. Observe & record the equilibration chamber relative humidity and temperature; enter to lab	Revise equilibration conditions and period. Repeat equilibration

	data form. Check for stability of lab's blank filter weights. Weight changes must be <15 ug before and after equilibration. Mean relative humidity between 30 and 40%, with a variability of not more than +/-5 percent standard deviation over 24 hours. Mean temp will be held between 20 and 23°C, with a variability of not more than +/-2 °C standard deviation over 24 hours.	
Initial filter weighing	Observe all weighing procedures. Perform all QC checks. Neutralize electrostatic charge on filters. Wait long enough so that the balance indicates a stable reading.	Repeat weighing
Internal QC	After every tenth filter, reweigh one of the two working standards. Weigh three laboratory filter blanks. Reweigh at least one duplicate filter with each sample batch (duplicate weighing). The working standard measurements must agree to within 3 ug of the certified values. The blank and duplicate measurements must agree to within 15ug	Flag values for validation activities.
Postsampling inspection, documentation, and verification	Examine the filter and field data sheet for correct and complete entries. If sample was shipped in a cooled container, verify that low temperature was maintained. No damage to filter. Field data sheet complete. Sampler worked OK.	Notify Lab Manager. Void sample.
Postsampling filter equilibration	Equilibrate filters for at least 24 hours. Must be within +/-5% RH of pre-sampling weighing conditions. Mean relative humidity between 30 and 40 %, with a variability of not more than +/-5 percent standard deviation over 24 hours. Mean temperature will be held between 20 and 23 °C, with a variability of not more than +/-2 °C standard deviation over 24 hours.	Repeat equilibration
Postsampling filter weighing	Observe all weighing procedures. Perform all QC checks. Neutralize electrostatic charge on filters. Wait at least 30 seconds after balance indicates a stable reading before recording data.	Repeat weighing

*The multipoint calibration for this method will be zero, 100 and 200 mg: 1) the required sample collection filters weigh between 100 and 200 mg; 2) the anticipated range of sample loadings for the 24-hour sample period is rarely going to be more than 200ug; and 3) the lowest, commercially available check weights that are certified according to nationally accepted standards are only in the single milligram range. Since the critical weight is not the absolute unloaded or loaded filter weight, but the difference between the two, the lack of microgram standard check weights is not considered cause for concern about data quality, as long as proper weighing procedure precautions are taken for controlling contamination, or other sources of mass variation in the procedure (see District's SOP).

13.5 Filter Sample Contamination Prevention, Preservation, and Holding Time Requirements

This element details the requirements needed to prevent and protect the filter sample from contamination, the volume of air to be sampled, temperature preservation requirements, and the permissible holding times to ensure against degradation of sample integrity.

13.5.1 Sample Contamination Prevention

The analytical support component of the PM_{2.5} network has rigid requirements for preventing sample contamination. Filters are equilibrated/conditioned and stored in the same room where they are weighed. Filters are only contacted with the use of smooth non serrated forceps. Upon determination of its pre-sampling weight, the filter is placed in its cassette, covered, and then placed in a protective petri dish or other protective transport case. The petri dish is labeled with a unique identifying number. The filter is never removed from the filter cassette outside of the weigh to prevent filter damage or contamination.

13.5.2 Sample Volume

The volume of air to be sampled is specified in 40 CFR Part 50. The sampling flow rate is 16.67 LPM. Total sample of air collected will be 24 cubic meters based upon a 24-hour sample.

13.5.3 Temperature Preservation Requirements

The temperature requirements of the PM_{2.5} network are explicitly detailed in 40 CFR Part 50. In the weighing room laboratory, the filters must be conditioned for a minimum of 24 hours prior to pre-weighing; although, a longer period of conditioning may be required. The weighing room laboratory temperature must be maintained between 20 and 23°C, with no more than a +/- 2°C standard deviation change over the 24 period prior to weighing the filters. During transport from the weighing room to the sample location, there are no specific requirements for temperature control; however, the filters will be located in their protective container and excessive heat avoided. Temperature requirements for the sampling and post sampling periods are detailed in 40 CFR Part 50, Appendix L Section 7.4.10. These requirements state that the temperature of the filter cassette during sampler operation and in the period from the end of sampling to the time of sample recovery shall not exceed that of the ambient temperature by more than 5°C for more than 30 minutes.

The specifics of temperature preservation requirements are clearly detailed in 40 CFR Part 50, Appendix L1. These requirements pertain to both sample media before collection and both the sample media and sample after a sample has been collected. Additionally, during the sample collection there are requirements for temperature control. The temperature requirements are detailed in Table 13.0.3.

Table 13.0.3 Temperature Requirements

Item	Temperature Requirement	Reference
Weighing Room	20 - 23° C	40 CFR Part 50, Appendix L, Section 8.2.1
Prew weighed Filter	+/- 2° C standard deviation for 24 hours prior to weighing	40 CFR Part 50, Appendix L, Section 8.2.2
Filter Temperature Control during sampling and until recovery	No more than 5° C above ambient temperature.	40 CFR Part 50, Appendix L, Section 7.4.10

Post Sample Transport	< 25°C if weighed within 10 days or < 4°C if weighed within 30 days	40 CFR Part 50, Appendix L, Section 8.3.6
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13.5.4 Permissible Holding Times

The permissible holding times for the PM_{2.5} sample are clearly detailed in both 40 CFR Part 501 and the U.S. EPA QA Guidance Document 2.122. A summary of these holding times were provided earlier and are found in Table 11.0.6 in Element 11.5.4.

References

The following documents were utilized in the development of this element:

U.S. EPA (1997a) National Ambient Air Quality Standards for Particulate Matter - Final Rule 40 CFR Part 50. Federal Register, 62(138):38651-38760. July 18,1997.

U.S. EPA Quality Assurance Guidance Document 2.12: Monitoring PM_{2.5} in Ambient Air Using Designated Reference or Class I Equivalent Methods. March 1998.

14.0 Quality Control Requirements

To assure the quality of data from air monitoring measurements, two distinct and important interrelated functions must be performed. One function is the control of the measurement process through broad quality assurance activities, such as establishing policies and procedures, developing data quality objectives, assigning roles and responsibilities, conducting oversight and reviews, and implementing corrective actions. The other function is the control of the measurement process through the implementation of specific quality control procedures, such as audits, calibrations, checks, replicates, routine self-assessments, etc. In general, the greater the control of a given monitoring system, the better will be the resulting quality of the monitoring data.

Quality control (QC) is the overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer. In the case of the Ambient Air Quality Monitoring Network, QC activities are used to ensure that measurement uncertainty, as discussed in Element 7, is maintained within acceptance criteria for the attainment of the DQO. Figure 14.0.1 represents a number of QC activities that help to evaluate and control data quality for the PM_{2.5} program. Many of the activities in this figure are implemented by the California ARB and are discussed in the appropriate sections of this QAPP. The other activities in this figure are implemented by the U.S. EPA.

14.1 QC Procedures

Day-to-day quality control is implemented through the use of various check samples or instruments that are used for comparison. The measurement quality objectives tables in Element 7 contain a complete listing of these QC checks as well as other requirements for the PM_{2.5} Program. The procedures for implementing the QC checks are included in the field and analytical methods (Elements 11 and 13, respectively). As Figure 14.0.2 illustrates, various types of QC checks have been inserted at phases of the data operation to assess and control measurement uncertainties. Tables 14.0.1 and 14.0.2 contain a summary of all the field and laboratory QC checks. The following information provides some additional

descriptions of these QC activities, how they will be used in the evaluation process, and what corrective actions will be taken when they do not meet acceptance criteria.

Table 14.0.1 Field QC Checks

Requirement	Frequency	Acceptance Criteria	CFR Reference	QA Guidance Doc. 2.12 Ref.	Information Provided
Calibration Standards					
Flow Rate Transfer Std.	1/yr	+/-2% of NIST traceable Std.	Part 50, App.L Sec 9.1, 9.2	Sec. 6.3	Certification of Traceability
Field Thermometer	1/yr	+/- 0.1°C resolution, +/- 0.5° C accuracy	not described	Sec 4.2 and 6.4	Certification of Traceability
Field Barometer	1/yr	+/- 1 mm Hg resolution, +/- 5 mm accuracy	not described	Sec. 4.2 and 6.5	Certification of Traceability
Flow Rate (FR) mult point verification	2/yr or if single-point verification failure	+/- 2% of xfer standard and +/-2% of design FR	Part 50, App.L, Sec 9.2	Sec 6.3 and 6.7	Calibration drift and memory effects
FR single point verification	1/4 weeks	+/- 4% of xfer standard and +/- 4% of design FR	Part 50, App.L, Sec 9.2.5, and Sec. 9.2.6	Sec 8.4	Calibration drift and memory effects
External Leak Check	every 5 sampling events	<80 mL/min	Part 50, App.L, Sec 7.4	Sec. 6.6 and Sec. 8.4	Sampler function
Internal Leak Check	every 5 sampling events	<80 mL/min	Part 50, App.L, Sec 9.3	Sec. 6.6 and Sec. 8.4	Sampler function
Temperature Calibration	2/yr	+/- 2°C of standard	Part 50, App.L, Sec 9.3	Sec. 6.4	Calibration drift and memory effects
Temp multi-point verification	on installation, then 2/yr	+/- 2°C of standard		Sec. 6.7 and 8.2	Calibration drift and memory effects
One- point temp Verification	1/4 weeks	+/- 4°C of standard	Part 50, App.L, Sec 7.4		Calibration drift and memory effects
Pressure Calibration	on installation, then 2/yr	+/-10 mm Hg		Sec. 6.5	Calibration drift and memory effects
Pressure Verification	1/4 weeks	+/-10 mm Hg		Sec. 6.7 and 8.2	Calibration drift and memory effects
Clock/timer Verification	1/ 4 weeks	+/- 1 min/mo		not described	Verification to assure proper function
Sampler function					
Field Blanks	10% of monitors sampling frequency	+/-30 ug	Part 50, App.L Sec 8.3	Sec. 7.7	Measurement system contamination
Precision Checks					
Collocated samples	every 6 days	CV < 10%	Part 58, App.A, Sec 3.5, 5.5	Sec. 10.2	Measurement system precision
Audits					
Flow audit	4/yr	+/- 4% of audit standard and +/- 5% of design FR	Part 58, App A, Sec 3.5.3	Sec 10.1 and 10.2	bias/accuracy

Temp Audit	1/yr	+/- 2°C	not described		Calibration drift and memory effects
Pres. Audit	1/yr	+/-10 mm Hg	not described		Calibration drift and memory effects

Table 14.0.2 Laboratory QC

Requirement	Frequency	Acceptance Criteria	CFR Reference	QA Guidance	Information gained
Lot Blanks	3 filters per lot	+/-15 ug difference	Not Defined	2.12 Sec. 7.7	Filter stabilization, equilibrium
Lab Blanks	3 per batch	+/-15 ug difference	Part 50, App. L, Sec 8.3	2.12 Sec. 7.7	Laboratory contamination
Balance Calibration	1/yr	Manufacturers spec.	Part 50, App. L, Sec 8.1	2.12 sec 7.2	Verification of equipment operation
Lab Temp. Calibration	3 mo.	+/- 2°C	Not Defined	QAPP Sec. 13/16	Verification of equipment operation
Lab Humidity Calibration	3 mo.	≈2%	Not Defined	QAPP Sec. 13/16	Verification of equipment operation
Balance Audit	1/year	+0.050 mg	Not Defined	2.12 Sec 10.1 and 10.2	Laboratory technician operation
Balance Check	every 10th sample	<3 mg	Not Defined	2.12 Sec. 7.9	Balance accuracy/stability
Working Mass Stds.	3 mo.	tolerance < 25 ug	Not defined	2.12 Sec 4.3 and 7.3	Standards verification
Primary Mass Stds	1/yr	tolerance < 25 ug	Not defined	2.12 Sec 4.3 and 7.3	Primary standards verification
Duplicate filter weighings	1 per weigh session	+/-15 ug difference	Not defined	2.12 Tab 7-1, Sec 7.11	Weighing repeatability/filter stability

14.1.1 Calibrations

Calibration is the comparison of a measurement standard or instrument with another standard or instrument to report, or eliminate by adjustment, any variation (deviation) in the accuracy of the item being compared. The purpose of calibration is to minimize bias.

For PM_{2.5}, calibration activities follow a two-step process:

Certifying the calibration standard and/or transfer standard against an authoritative standard, and
Comparing the calibration standard and or transfer standard against the routine sampling / analytical instruments.

Calibration requirements for the critical field and laboratory equipment are found in Tables 14.0.1 and 14.0.2, respectively; the details of the calibration methods are included in the calibration Element and in the field and laboratory methods Elements.

14.1.2 Blanks

Blank samples are used to determine contamination arising from principally four sources: the environment from which the sample was collected/analyzed, the reagents used in the analysis, the apparatus used, and the operator/analyst performing the data operation. Three types of blanks will be implemented in the PM_{2.5} Program:

Lot Blanks - a shipment of 46.2mm filters will be periodically sent from U.S. EPA to the ARB. Each shipment must be tested to determine the length of time it takes the filters to stabilize. Upon arrival of each shipment, three lot blanks will be randomly selected from the shipment and be subjected to the conditioning/pre-sampling weighing procedures. The blanks will be weighed daily for a minimum of five days to determine the length of time it takes to maintain a stable weight reading.

Field Blanks - provides an estimate of total measurement system contamination. By comparing information from laboratory blanks against the field blanks, one can assess contamination from field activities. Details of the use of the field blanks can be found in field SOPs (Appendix E).

Lab Blanks -provides an estimate of contamination occurring at the weighing facility. Details of the use of the lab blanks can be found in lab's SOP.

Lab Blank Evaluation

Three (3) lab blanks will be weighed in each weighing session. The following statistics will be used for data evaluation purposes:

Difference for a Single Check - The difference, for each check is calculated using the weight of the filter measured from its previous weighing and the weight of the filter measured from the current weighing session.

The Mean Difference for the Batch - The mean difference for lab blanks within a weighing session batch is calculated using individual differences divided by the number of blanks in the batch.

Corrective Action - The acceptance criteria for lab blanks is 15 ug difference. However, the mean difference based upon the number of blanks in each batch will be used for comparison against the acceptance criteria. If the mean difference of the laboratory blanks is greater than 15ug, then the laboratory balance will be checked for proper operation and all the lab blanks in the weighing session will be re-weighed. Prior to re-weighing, the laboratory balance will be checked for proper operation. If the blank mean is still out of the acceptance criteria, all samples within the weighing session will be flagged with the appropriate flag, and efforts will be made to determine the source of contamination. If the mean difference of the laboratory blanks is greater than 20ug and 2 or more of the blanks were greater than 15ug, the laboratory weighing will stop until the issue is satisfactorily resolved. The laboratory analyst will alert the Laboratory Manager of the problem. The problem and solution will be reported and appropriately filed under response and corrective action reports.

Field Blank Evaluation

Field blanks will be weighed in the same weighing session as associated routine samples from the site. The following statistics will be generated for data evaluation purposes:

Difference for a Single Check - The difference is calculated using the difference in weight before and after transport to and from the monitoring site including exposure in the sampler.

Corrective Action - The acceptance criteria for field blanks is 30 ug difference. If the field blank value is out of the acceptance criteria, efforts will be made to determine the source of contamination. In theory, field blanks should contain more contamination than laboratory blanks. Therefore, if the field blanks are outside of the criteria while the lab blanks are acceptable, weighing can continue on the next batch of samples while field contamination sources are investigated. The laboratory analyst will alert

the Laboratory Manager. The problem and solution will be reported and appropriately filed under response and corrective action reports.

14.1.3 Precision Checks

Precision is the measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. In order to meet the data quality objectives for precision, the District ensures the entire measurement process is within statistical control. Two types of precision measurements are made in the PM_{2.5} Program.

Collocated Monitoring / Filter Duplicates

Collocated Monitoring

In order to evaluate total measurement precision, collocated monitoring will be implemented, as referenced in 40 CFR. Therefore, every method designation will have 25% of the monitors collocated. The location of these monitors is described in the 1998 California Particulate Matter Monitoring Network Description, but it is anticipated that these sites will collect concentrations around the NAAQS, or will be sites where higher concentrations are expected.

Evaluation of Collocated Data

Collocated measurement pairs are selected for use in the precision calculations only when both measurements are above 6 ug/m³. However, all collocated data will be reported to AIRS. The algorithms are included in 40 CFR Part 58 Appendix A, and are incorporated by reference

Corrective Action

The precision data quality objective of 10% coefficient of variation (CV) is based upon the evaluation of three years of collocated precision data. The goal is to ensure that precision is maintained at this level. Therefore, precision estimates for a single pair of collocated instruments, or even for a quarter, may be greater than 10% while the three year average is less than or equal to 10%. Therefore, single collocated pairs with values >10% will be flagged and reweighed. If the value remains between 10-20%, the field technician will be alerted to the problem. If the CV is greater than 20% CV for both the initial and reweigh, all the primary sampler data will be flagged from the last precision check and corrective action will be initiated. Paired CVs and percent differences will be control charted to determine trends. The laboratory technician will alert the Laboratory Manager of the problem. The problem and solution will be reported and appropriately filed under response and corrective action reports.

Duplicate Laboratory Measurements

During laboratory pre-weighing and post-weighing sessions, a routine filter from the sampling batch will be selected for a second weighing. The difference among the weights of these two filters must be less than 15ug. If this criterium is not met, the pair of values will be flagged. Failure may be due to transcription errors, microbalance malfunction, or that the routine samples have not reached equilibrium. Other QC checks (balance standards and lab blanks) will eliminate microbalance malfunction. If the duplicate does not meet the criterium, a second routine sample will be selected and reweighed as a second duplicate check. If this second check fails the acceptance criteria and the possibility of balance malfunction and transcription errors have been eliminated, all samples in the batch will be equilibrated for another 24 hours and reweighed. Corrective actions will continue until duplicate weights for the batch meet acceptance criteria.

14.1.4 Accuracy or Bias Checks

Accuracy is defined as the degree of agreement between an observed value and an accepted reference value. Four accuracy checks are implemented in the PM2.5 program:

- Collocated monitors
- Flow rate audits
- Balance checks
- FRM performance evaluations

Collocated Monitors

Although the collocated monitors are primarily used for evaluating and controlling precision, they can be used to determine accuracy or bias. By using Equation 19 to determine percent difference, one can track trends or bias between the two instruments without knowing which instrument is producing the true value. Use of the FRM performance evaluation information in conjunction with collocation data should help improve the quality of data.

Corrective Action - If it appears that there is a statistically significant bias ($> 10\%$ at the 90% confidence level) between the pairs, corrective action will be initiated. The process will include eliminating uncertainties that may be occurring at filter handling, transport and laboratory stages, in order to determine that the bias is truly at the instrument. Corrective actions at the instrument will include multi-point temperature, pressure, and flow rate checks as well as complete maintenance activities. Additional corrective action could include a request for vendor servicing or a request for Region IX to implement an FRM performance evaluation.

Flow Rate Audits

Flow rate audits are performed quarterly either by EPA contractors or ARB. Details of the implementation aspects of the audit are included in Element 11. The audit is made by measuring the analyzer's normal operating flow rate using a certified flow rate transfer standard. The flow rate standard used for auditing will not be the same flow rate standard used to calibrate the analyzer. However, both the calibration standard and the audit standard may be referenced to the same primary flow rate or volume standard. Auditors will report the audit (actual) flow rate and the corresponding flow rate indicated or assumed by the sampler.

Corrective Action - The single sampler accuracy requirement is $\pm 4\%$ of the audit transfer standard and $\pm 5\%$ of design flow rate. If the audit shows performance outside of the acceptance criteria, the sample operator will check the sampling instrument for internal and external leaks, ensure that temperature and pressure are within acceptable ranges, and verify the flow rate. A re-audit will be scheduled. If the audit is still unacceptable, a multi-point calibration followed by a one-point verification is required. Routine data, back to an acceptable audit or the most recent multi-point calibration, will be flagged and reviewed to determine validity. In addition, one would expect that the flow rate calibration verification checks that will be conducted every five sampling events would indicate a drift towards unacceptable accuracy. If a review of the flow rate calibration verification check data does not show a problem, there is a potential that one or both of the flow rate standards need to be re-certified.

Balance Checks

Balance checks are frequent checks of the balance working standards (100 and 200 mg standards)

against the balance to ensure that the balance is within acceptance criteria throughout the pre- and post-sampling weighing sessions. The District will use ASTM class 1 weights for its primary and secondary (working) standards. Both working standards will be measured at the beginning and the 200 mg standard will once again be weighed at the end of the sample batch. In addition, one standard will be selected for a measure after every 10 filters. Balance check samples will be logged.

Difference for a Single Check

The difference for each check is calculated from the certified mass weight and measured weight .

Corrective Action - The difference among the reported weight and the certified weight must be $< 4\mu\text{g}$. Since this is the first check before any pre- or post-sampling weighings, if the acceptance criteria is not met, corrective action will be initiated. Corrective action may be as simple as resetting the internal calibration (per manufacturers guidelines) or to sufficiently warm-up, which may require checking the balance weights a number of times. If the acceptance criteria is still not met, the laboratory technician will be required to verify the working standards to the primary standards. Finally, if it is established that the balance does not meet acceptance criteria for both the working and primary standards, and other troubleshooting techniques fail, the Quality Control Services service technician will be called to perform corrective action.

If the balance check fails acceptance criteria during a run, the 10 filters weighed prior to the failure will be reweighed. If the balance check continues to fail, troubleshooting, as discussed above, will be initiated. The values of the 10 samples weighed prior to the failure will be recorded and flagged, but will remain with the un-weighed samples in the batch to be reweighed when the balance meets the acceptance criteria. Any balance check outside the acceptance criteria will be flagged in the logbook.

FRM Performance Evaluation

The Federal Reference Method (FRM) Performance Evaluation is a quality assurance activity which will be used to evaluate measurement system bias of the PM_{2.5} monitoring network. The pertinent regulations for this performance evaluation are found in 40 CFR Part 58, Appendix A, section 3.5.32. The strategy is to collocate a portable FRM PM_{2.5} air sampling instrument with an established routine air monitoring site, operate both monitors in exactly the same manner, and then compare the results of this instrument against the routine sampler at the site. The U.S. EPA will be implementing this program and will inform the District when an evaluation will be conducted. The evaluation will be conducted on a regularly scheduled sampling day and the filters from the evaluation instrument will be sent to a national laboratory in Region 10 for measurement. The comparison of data will be accomplished by U.S. EPA personnel using the Aerometric Information Retrieval System (AIRS) data base. It must be noted that the performance evaluation is an estimate of the uncertainty of the measurement system and not the instrument. Therefore, biases may be attributed to sample handling, transportation and laboratory activities as well as to the instrument. The statistics used in the assessment are included in 40 CFR Part 582.

Corrective Action - The U.S. EPA will notify the District of the evaluation results within 10 days of receiving the results. The bias acceptance criteria for the data comparison is $\pm 10\%$. If it appears that there is a bias, corrective action will be initiated. The process will include an attempt to determine at what data collection phase(s) the majority of the measurement errors are occurring. This may require that Region IX conduct additional FRM performance evaluations to troubleshoot the process.

14.2 Sample Batching

In order to ensure that the District can review all types of QC samples within a weighing session, the District may use the concept of sample batches. A batch of samples will consist of all routine and QC sample filters weighed in the laboratory on any given day. QC samples will be interspersed within the batch in order to provide data quality information throughout the batch weighing session.

References

1. Taylor, J.K. 1987 Q.A. of Chemical Measurements. Lewis Publishers, Chelsea, Michigan. 328pp.
2. U.S. EPA (1997b) Revised Requirements for Designation of Reference and Equivalent Methods for PM_{2.5} and Ambient Air Quality Surveillance for Particulate Matter-Final Rule. 40 CFR Parts 53 and 58. Federal Register, 62(138):38763-38854. July 18, 1997.

15.0 Instrument/Equipment Testing, Inspection and Maintenance Requirements

15.1 Purpose/Background

The purpose of this element in the District's QAPP is to discuss the procedures used to verify that all instruments and equipment are maintained in sound operating condition and are capable of operating at acceptable performance levels. All instrument inspection and maintenance activities are documented in the District's laboratory and field operations SOPs (Appendix B and Appendix E, respectively).

15.2 Testing

All PM_{2.5} samplers used will be designated federal reference methods (FRM) that have been certified as such by U.S. EPA. Therefore, they are assumed to be of sufficient quality for the data collection operation. Testing of such equipment is accomplished by U.S. EPA through the procedures described in 40 CFR Part 50. Prior to field installation, the ARB assembled and ran the samplers at the acceptance laboratory. Once installed at the site, District staff ran external and internal leak checks and temperature, pressure and flow rate multi-point verification checks. It was determined that the sampling instrument met the acceptance criteria, and was assumed to be operating properly. These tests were documented and filed as indicated in Element 9.

15.3 Inspection

Inspection of various equipment and components is provided here. Inspections are subdivided into two Elements: one pertaining to weigh room laboratory issues and one associated with field activities.

15.3.1 Inspection in Weigh Room Laboratory

There are several items that need routine inspection in the weigh room laboratory. Table 15.0.1 details the items to inspect and how to appropriately document the inspection.

Table 15.0.1 Inspections in the Weigh Room Laboratory

Item	Inspection Frequency	Inspection Parameter	Action if Item Fails Inspection	Documentation Requirement
Weigh room Temperature	Daily	20 - 23° C	1) Check HVAC System 2) Call for service	1) Document in weigh room log book 2) Notify Lab Manager
Weigh Room Humidity	Daily	30 - 40 %RH	1) Check HVAC System 2) Call for service	1) Document in weigh room log book 2) Notify Lab Manager

Dust in Weigh Room	Monthly	Visually inspect	Clean Weigh Room	Document in Weigh Room log book
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15.3.2 Inspection of Field Items

There are several items to inspect in the field before and after a PM2.5 sample has been taken. Table 15.0.2 details the inspections performed in the field before and after samples are taken.

Table 15.0.2 Inspection of Field Items

Item	Inspection Frequency	Inspection Parameter	Action if Item Fails Inspection	Documentation Requirement
Sample downtube	Every site visit	Visible particulate	Clean with a clean dry cloth	Document in log book
WINS Impactor well	Every site visit	“Cone” shape of particulate on impactor well	Replace impactor well (including new impactor oil)	Document in log book
Rain collector	Every site visit	>1/3 full	Empty	Document in log book
O-rings	Every site visit	Any damage	Replace	Document in log book
Filter Cassettes	After each sample run	Visible particulate	Check downtube and WINS impactor	Document in log book
Cassette Seals	Each sample	Clean and smooth	Clean with a clean dry cloth, or replace as need	Document when replaced
In-line filter	Every 6 months	Loaded particulate	Replace	Document in log book
Battery	Every 6 months	Decrease in voltage	Replace	Document in log book

15.4 Maintenance

There are many items that need maintenance attention in the PM2.5 network. This Element describes those items according to whether they are weigh room items or field items.

15.4.1 Weigh Room Maintenance Items

The successful preventive maintenance program for the weigh room laboratory will go a long way towards the success of the entire PM2.5 program. In the District’s PM2.5 network, weigh room laboratory preventive maintenance is handled internally with the availability of outside contractors. As the building owner, the District takes care of all preventive maintenance associated with the heating, ventilation, and air conditioning system (HVAC). Preventive maintenance for the microbalance is performed by the District, and/or an service company such as a Sartorius service technician. Preventive maintenance for the microbalance is scheduled to occur at initial set-up and every 12 months thereafter. In the event that there is a problem with the microbalance that cannot be resolved by District staff, a service technician can be contacted. The service technician will also have a working micro- balance in his/her possession that will be loaned to the District in case that the District’s microbalance cannot be repaired on-site.

Annual calibration services with Sartorius Corporation are expected to be renewed each year. In the event a service agreement is not renewed, a new service provider will be selected and contract put in place.

The following table details the weigh room maintenance items, how frequently they will be replaced, and who will be responsible for performing the maintenance.

Table 15.0.3 Preventive Maintenance in the LCAQMD Weigh Room Laboratory

Item	Maintenance Frequency	Responsible Party
Multi-point Microbalance maintenance	Yearly	Contractor

calibration	Yearly	
Polonium strip replacement	6 Months	District
Comparison of NIST Standards to laboratory working and primary standards	Yearly	Contractor
Cleaning weigh room	Monthly	District
HVAC air filter replacement	Monthly	District
Clean sticky floor mat (just outside weigh room)	3 Months	District
HVAC system preventive maintenance	Yearly	District or Contractor
Computer system preventive maintenance back-up.	Monthly	District

15.4.2 Field Maintenance Items

There are many items associated with appropriate preventive maintenance of a successful field program. Table 15.0.4 details the appropriate maintenance checks of the PM2.5 samplers and their frequency.

Table 15.0.4 Preventive Maintenance of Field Items

Item	Maintenance Frequency	Location Maintenance Performed
Clean WINS PM2.5 Impactor	Every 5 sample episodes	At Lab/Office
Clean PM10 Inlet	Monthly	At Site
Inspect Filter Cassettes	Each run	At Lab
Replace In-line filter	6 Months	At Site
Inspect Air Screens (under sampler's rain hood)	6 Months	At Site
Clean filter holding area, internal and external	Monthly	At Site
Sample Pump Rebuild	Every 10,000 hours of operation	At Lab

References

The following documents were utilized in the development of this Element:

- 1) U.S. EPA (1997a) National Ambient Air Quality Standards for Particulate Matter - Final Rule. 40 CFR Part 50. *Federal Register*, 62(138):38651-38760. July 18,1997.

16.0 Instrument Calibration and Frequency

16.1.0 Instrumentation Requiring Calibration

16.1.1 Mass Analysis by Gravimetry – Laboratory Microbalance

The laboratory support for the LCAQMD, includes calibration of the Cahn C-32 microbalance. As indicated in Element 13, the balance is calibrated (and mass standard check weights re-certified) once a year. The service technician performs routine maintenance and makes any balance response adjustments that the calibration shows to be necessary. During the year (annually), both the in-house primary and secondary (working) standards are checked against NIST mass standards by Troemner. These actions are documented in the service technician's report, a copy of which is provided to the laboratory services manager, which after review, is filed in the Balance Room record center.

16.1.2 Flow Rate - Laboratory

LCAQMD performs the calibrations and calibration checks with a NIST-traceable primary flow rate standard (Gilian Gilibrator). Field personnel use the Gilibrator for all field calibrations of the R&P sampler. This type of device has the advantage of providing volumetric flow rate values directly,

without requiring conversion from mass flow measurements, temperature, pressure, or water vapor corrections. The unit is available for re-certification upon request.

Upon initial receipt of any new, repaired, or replaced PM 2.5 sampler, District field staff will perform a multipoint flow rate calibration validation on the sampler flow rate to determine if initial performance is acceptable. Once sampler flow rates are accepted, field personnel perform the calibration and validations at the frequency specified in Element 14.

16.1.3 Sampler Temperature, Pressure, Time Sensors – Laboratory

The District performs all calibrations and calibration checks of temperature and pressure sensors by comparisons to NIST certified equipment.

A NIST certified thermometer is used as a primary standard to calibrate all temperature sensors in the field and laboratory. In addition, the District maintains an NIST certified Assmann Psychrometer for calibration of instruments measuring relative humidity. This also provides a pair of back-up thermometers as well.

A Fortin mercury type of barometer located in the District laboratory is used to calibrate and/or validate the aneroid barometer used in the field to verify the barometric sensors of PM2.5 samplers.

The LCAQMD utilizes a NIST Time calibration service (satellite) with headquarters located in Boulder, Colorado, to verify the time on a central lab time device, to which other lab and field devices, including the volumetric FRM samplers, are compared.

16.1.4 Field

All necessary field calibrations are performed with the same certified equipment as utilized in the laboratory. The calibration of FRM samplers are performed using the Gilibrator (primary standard), NIST certified thermometers, and barometer. (See District SOP).

The following calibrations are performed in the field or at ARB Standards Laboratory:

- calibration of MFM in FRM samplers against the working or primary standards
- calibration of sampler temperature and pressure sensors against the working temperature standard and working pressure standard
- calibration checks of the thermometers used in the field during filter transport.

The field equipment and calibration instruments will follow the calibration and re-certification schedule as listed in Table 16.0.1.

Table 16.0.1 Field Equipment Calibration/Certification Schedule

Instrument	Frequency
R&P Single Filter Sampler	Quarterly or if verification check fails
Mass Flow Meter	“
Ambient Temperature Sensor	“
Filter Temperature Sensor	“
Ambient Pressure Sensor	“
Calibration Gilibrator (Primary Standard)	Primary Standard, As requested by ARB
Calibration / Verification Class A Thermometer	NIST Primary Standard, As requested by ARB
Calibration / Verification Mercury Barometer	NIST Primary Standard , As requested by ARB
Clock/Timer Verification Standard	N/A

16.2.1 Laboratory – Gravimetric (Mass) Calibration

The calibration and QC (verification) checks of the microbalance are addressed in Elements 13.3 and 16.1.1 and Appendix B of this QAPP. For the following 3 reasons, the multipoint calibration for this method will be zero, 100 and 200ug: 1) the required sample collection filters weigh between 100 and

200 mg; 2) the anticipated range of sample loading for the 24 hour sample period is rarely going to be more than 200 ug; and 3) the lowest, commercially available check weights that are certified according to nationally accepted standards are only in the single milligram range. Since the critical weight is not the absolute unloaded or loaded filter weight, but the difference between the two, the lack of microgram standard check weights is not considered cause for concern about data quality, as long as proper weighing procedure precautions are taken for controlling contamination, or other sources of mass variation in the procedure.

16.2.2 Laboratory and Field - Flow Calibration

The District will conduct spot checks of lab and field notebooks to ensure that the lab and field personnel are following the SOPs, including the OA/QC checks, acceptance criteria and frequencies listed in Tables 6-4 and 7-4 in Sections 6 and 7.

Monthly Maintenance QC Documentation will be submitted to the Air Monitoring Manager monthly to ensure QA/QC checks are being performed per scheduled frequencies listed in Tables 6-4 and 7-4 in Elements 6 and 7, respectively.

Method Summary

Audits and/or calibrations will be conducted according to the manufactures recommendation and procedures contained in the Rupprecht & Patashnick Partisol Model 2000 Operating Manual, Section 10.

After equilibrating the calibration device to the ambient conditions of the sampler, install a filter cassette containing an unused 46.2 mm filter in the sampler. After removing the inlet from the sampler, connect the flow calibration device on the sampler down tube. If the sampler has not been calibrated before, or if the previous calibration was not acceptable, perform a leak check according to the manufacturer's operational instruction manual, which is incorporated into the District's SOP.

Otherwise, place the sampler in calibration mode and perform a three-point calibration/verification or a one-point flow rate verification. The field staff will only perform a leak check after calibration or if verification is outside of the acceptance criteria.

16.2.3 Sampler (and Laboratory-Weighing Room- Environmental Control) Temperature Calibration Procedure

Sampler

Audits and/or calibrations will be conducted according to the manufactures recommendation and procedures contained in the Rupprecht & Patashnick Partisol Model 2000 Operating Manual, Section 10. Temperature sensors will be calibrated at least once per quarter.

Both the ambient air and filter temperature sensors will be calibrated (or checked) once per month. If found operating outside of their prescribed limits, the sensors are re-calibrated.

The ambient air sensor is located inside the shielded fixture on the outside of the PM2.5 sampler and is easy to unfasten and remove for comparison to a transfer standard for temperature. The three-point verification/calibration will be conducted at the field site.

The filter temperature sensor is located in the (open) space just below the filter cassette. It is threaded through the walls of the filter cassette holding assembly section of the sampler and removal of plastic or metal fittings is required to remove the sensor and its associated wiring. It may be difficult to calibrate this sensor in the field. The District wedges the NIST certified thermometer into the bottom half of the open filter holder. The thermometer is secured in place and wrapped (along with the filter thermometer) with bubble wrap to equilibrate the two. Be careful when removing the filter temperature sensor do not gall the fittings since this could start an internal leak after the installation. A sampler leak check must be performed after reinstallation of the filter temperature sensor.

Several steps to follow in calibrating the ambient air temperature sensor are given in the SOP and in the following summary. Refer to the operator's instruction manual for sampler-specific procedures and instructions.

Remove the ambient temperature sensor from the radiation shield. Prepare a convenient container (an insulated vacuum wide mouth thermos bottle) for the hot temperature water bath, ambient temperature water bath and the ice slurry bath. Wrap the sensor(s) and a thermometer together with rubber band; ensure that all the probes are at the same level. Prepare the ambient or ice slurry solution according to the SOP in Appendix E. Immerse the sensor(s) and the attached thermometer in the ambient temperature bath. Wait at least 5 minutes for the ambient thermal mass and the sensor/thermometer to equilibrate. Wait at least 15 minutes for equilibration with the ice slurry before taking comparative readings.

For each thermal mass, in the order: Ambient, Cold, Ambient, Hot, and Ambient make a series of five measurements, taken about one minute apart. If the measurements indicate equilibrium, average the five readings and record the result as the sensor temperature relative to the thermometer.

A similar process will be used to verify the calibration of continuously reading temperature sensors used in the laboratory weighing room.

Laboratory

Temperature/RH The temperature and relative humidity monitoring equipment (Dickson Relative Humidity/Temperature Recorder, Davis Instruments Weather Monitor II Temperature and Relative Humidity sensor/logger) will be calibrated on a quarterly schedule. The quarterly calibrations will be supplemented by monthly calibration checks. Calibration values will be provided by: an Assmann Psychrometer (NIST-certified) for calibration of instruments measuring relative humidity; and a Precision thermometer (NIST certified No. 263364-00, 213426) for calibration of instruments measuring temperature.

16.2.4 Sampler Pressure Calibration Procedure

Calibrations will be conducted according to the manufactures recommendation and procedures contained in the Rupprecht & Patashnick Partisol Model 2000 Operating Manual, Section 10.

General: According to ASTM Standard D 3631 (ASTM 1977), a barometer can be calibrated by comparing it with a secondary standard traceable to a NIST primary standard.

Precautionary Note: Protect all barometers from violent mechanical shock and sudden changes in pressure. A barometer subjected to either of these events must be recalibrated. Maintain the vertical and horizontal temperature gradients across the instruments at less than 0.1°C/m. Locate the instrument so as to avoid direct sunlight, drafts, and vibration.

A Fortin mercury type of barometer will be used at the LCAQMD to calibrate and validate the aneroid barometer used in the field to verify the barometric sensors of PM_{2.5} samplers. Details are provided in 16.4.1, below, and in Appendix E.

16.2.5 Sampler and Standard Volumetric Flow Rate Sensors with Built-in Clocks

Time can be verified using Oregon Scientific "Time Machine" (direct satellite download from NIST in Boulder, Colorado).

16.2.6 Procedure for Verifying Relative Humidity Control/Monitoring data for the Filter Conditioning / Weighing Room - Laboratory Only

An NIST-traceable thermometer is used by laboratory personnel to verify the temperature and an Asman psychrometer is used to verify the relative humidity recorded by a weekly chart recorder used to continuously monitor environmental conditions within the weighing room. For details, see Appendix B.

16.3 Calibration Standard Materials and Apparatus

Table 16-1 presents a summary of the specific standard materials and apparatus used in auditing and/or calibrating measurement systems for parameters necessary to generating the PM data required in 40 CFR 2.5 parts 50, Appendix L, and part 58.

Table 16-1 Standard Materials and/or Apparatus for PM Calibration 2.5

Parameter M-Material A-Apparatus	Std. Material	Std. Apparatus	Mfr. Name	Model #	Variable Control Settings
Temperature M+A	Hg	Thermometer	WeatherMeasure	5231 PTS	n/a
Pressure M+A	Hg	Barometer	Princo	Nova PPS	n/a
Flow A		Bubble Meter	Gilian	Gilibrator PFS	n/a

Table 16.0.2 presents a summary of the specific standard materials and apparatus used in calibrating measurement systems for parameters necessary to generate the PM_{2.5} data required in 40 CFR Part 50, Appendix L, and Part 58.

Table 16.0.2 Standard Materials and/or Apparatus for PM_{2.5} Calibration

Parameter (M-Material A=Apparatus)	Std. Material	Std. Apparatus	Mfr. Name	Model #	Variable Control Settings
Mass M	Standard Check weight	NA	TBD	TBD	NA
Temperature M+A M+A M+A	Hg H2O NA	Thermometer Thermal mass (Thermos) Thermistor	TBD TBD TBD	TBD TBD TBD	* NA *
Pressure M+A A	Hg NA	Fortin Aneroid	TBD		* *
Flow Rate A A A A	NA	Piston Meter Dry Gas Meter Mass Flow Meter Adapter	Brooks, Sierra TBD TBD Andersen, R&P		* NA NA
Relative Humidity A	NA	Assman Psychrometer	Assman Corp.		

*- See manufacturer's operating manual an/or instruction sheet

16.4 Calibration Standards

16.4.1 Lab

Barometric Pressure

The LCAQMD pressure standard is a Fortin-type mercury barometer.

Flow Rate

The flow rate standard apparatus used for flow-rate calibration (Gillian Gilibrator) is of the type referred to as a primary flow standard. As such, it has its own certification and is NIST-traceable. A calibration relationship for the flow-rate standard, such as an equation, curve, or family of curves, is established by the manufacturer (and verified if requested by ARB) that is accurate to within 2% over the expected range of ambient temperatures and pressures at which the flow-rate standard is used. The LCAQMD flow rate standard's calibration will be compared to the ARB Brooks primary standard as determined and as requested by the ARB.

The actual frequency with which this recertification process must be completed depends on the type of flow rate standard- some are much more likely to be stable than others. Air Monitoring will maintain a control chart (a running plot of the difference or % difference between the flow-rate standard and the NIST-traceable primary flow-rate or volume standard) for all comparisons. In addition to providing excellent documentation of the certification of the standard, a control chart also gives a good indication of the stability of the standard. If the two standard-deviation control limits are close together, the chart indicates that the standard is very stable and could be certified less frequently. The minimum recertification frequency is once per year. On the other hand, if the limits are wide, the chart would indicate a less stable standard that will be recertified more often. Also, field staff who conduct field calibrations will track changes from recertification to recertification to assure that performance is not compromised.

Temperature

The operations manuals associated with the single and sequential samplers identify types of temperature standards recommended for calibration and provide a detailed calibration procedure for each type that is specifically designed for the particular sampler.

The U.S. EPA Quality Assurance Handbook, Volume IV (EPA 1995), Section 4.3.5.1, gives information on calibration equipment and methods for assessing response characteristics of temperature sensors.

The temperature standard used for temperature calibration will have its own certification and be traceable to a NIST primary standard. A calibration relationship to the temperature standard (an equation or a curve) will be established that is accurate to within 2% over the expected range of ambient temperatures at which the temperature standard is to be used. The temperature standard must be reverified and recertified at least annually. The actual frequency of recertification depends on the type of temperature standard; some are much more stable than others. The best way to determine recertification requirements is to keep a control chart. The District will use an ASTM- or NIST-traceable mercury in glass thermometer, for laboratory calibration.

Temperature Standards

The temperature standards used by the District are NIST traceable thermometers. Each have been calibrated against temperature standards the manufacturers obtained from NIST.

The District's laboratory standard is a NIST-traceable glass mercury with a certificate summarizing the NIST traceability protocol and documenting the technician's signature, comparison date, identification of the NIST standard used, and the mean and standard deviation of the comparison results.

The District's uses the same equipment for use as the field temperature standard.

Pressure

The Fortin mercurial type of barometer works on fundamental principles of length and mass and is therefore more accurate but more difficult to read and correct than other types. By comparison, the precision aneroid barometer is an evacuated capsule with a flexible bellows coupled through mechanical, electrical, or optical linkage to an indicator. It is potentially less accurate than the Fortin type but can be transported with less risk to the reliability of its measurements and presents no damage from mercury spills. The Fortin type of barometer is best employed as a higher quality laboratory standard that is used to adjust and certify an aneroid barometer in the laboratory. If technology is

available and warrants change, the District will switch to a digital pressure barometer that can be calibrated against the Fortin mercurial type of barometer. Currently the cost of digital equipment is too prohibitive for District budget to afford.

16.4.2 Field

Flow Rate

The flow rate standard apparatus used for flow-rate calibration (NIST traceable manual soap bubble flow meter and time monitor) has its own certification and is traceable to other standards for volume or flow rate which is itself NIST-traceable. A calibration relationship for the flow-rate standard has been established by the ARB that is accurate to within 2% over the expected range of ambient temperatures and pressures at which the flow-rate standard is used. The flow rate standard apparatus is re-certified annually. If applicable, the ARB maintains a history of all performed re-certifications.

Temperature

The District standards are 3 NIST-traceable glass mercury thermometers from the WeatherMeasure Weathertronics Company, each with its own calibration certificate including protocol and documenting the technician's signature, comparison date, and the comparison results. There are 2 thermometers (one and one back up) which span the complete range of typically measured summer to winter field temperature values. The temperature sensor standards chosen by the lab staff and managers have been standardized against temperature standards the manufacturer obtained from NIST, and/or the ARB. If applicable, the ARB will maintain a history of all re-certifications.

Pressure

The Princo Fortin-type mercurial barometer is a primary standard and works on fundamental principles of length and mass, and is located on site as a higher quality laboratory standard used for the laboratory located sampler.

16.5 Document Calibration Frequency

See Table 14-1 for a summary of field QC checks that includes frequency and acceptance criteria and references for calibration and verification tests of sampler flow rate, temperature, pressure, and time. See Table 14-2 for a similar summary of laboratory QC, including frequency of primary and working mass standards and conditioning/weighing room temperature and relative humidity. The field sampler flow rate, temperature and pressure sensor verification checks include 1-point checks at least monthly and multi-point checks at least annually. All of these events, as well as sampler and calibration equipment maintenance will be documented in field data records and/or notebooks. Laboratory and field activities associated with equipment used will be kept in record notebooks. The records will normally be controlled by the District, located in the lab or field sites when in use, or at the District office when being reviewed or used for data validation. All records and logs shall be provided to ARB and/or USEPA staff upon request during inspection and/or audit, and duplicates of records shall be provided upon request. All records shall be maintained and be available for not less than five (5) years. All of these events, as well as sampler and calibration equipment maintenance will be documented in field data records and notebooks and annotated with the flags required in Appendix L of 40 CFR Part 50, the manufacturer's operating instruction manual and any others indicated in Element 22.7.2 of this document. Laboratory and field activities associated with equipment used by the respective technical staff will be kept in record notebooks as well. The records will normally be controlled by the lab manager, and located in the lab or field sites when in use or at the District office when being reviewed or used for data validation.

17.0 Inspection/Acceptance for Supplies and Consumables

17.1 Purpose

The purpose of this element is to establish and document a system for inspecting and accepting all supplies and consumables that may directly or indirectly affect the quality of the PM2.5 program. The LCAQMD's PM2.5 monitoring network relies on various supplies and consumables that are critical to

successful operation. By having documented inspection and acceptance criteria, consistency of the supplies can be assured. This Element details the supplies/consumables, their acceptance criteria, and the required documentation for tracking this process. The District will follow the California ARB guidelines where appropriate.

17.2 Critical Supplies and Consumables

There are many components to the PM_{2.5} monitoring network. This Element attempts to describe the needed supplies for this PM_{2.5} monitoring network and includes items for the weighing room laboratory and field activities. Table 17.0.1 details the various components:

Table 17.0.1 Critical Supplies and Consumables

Area	Item	Description	Vendor	Model Number
Sampler	Impactor Oil	Tetramethyltetra-phenyl-trisiloxane (30ml)	Dow Corning	704 Oil
Sampler	37 mm Glass Fiber Filter	For use in impactor well	R&P	
Sampler	Rain Collector	Glass	R & P	To be determined
Sampler	O-Rings	The O-rings that seal in the filter cassette when it is placed in the sampler.	R&P	
Sampler	In-line Filter	Downstream of sample collection and upstream of sample pump.	R & P	To be determined
Sampler	Battery	Internal Sampler Battery.	R & P	To be determined
Sampler	Fuses	In sampler	R & P	To be Determined
Sampler	Floppy Disks or CDR's	3.5" Pre-formatted	Purchase local	
Filter	Filters	46.2 mm Teflon	Whatman	
Filter	Petri-dish	47 mm with securing ring.	Whatman, Gelman or Millipore	7231
Filter	Filter Cassettes (single)	As per CFR design	R&P	N/A
Filter	Filter Cassette Holder, Protective Containers	For securing cassette	R&P	N/A
Filter	Filter Handling Containers	For transport to and from the field	R&P	N/A
Weigh Room	Staticide	Anti-static solution	Cole-Parmer	E-33672-00
Weigh Room	Static Control Strips	Polonium 500 _i	NRD	StaticMaster
Weigh Room	Air Filters	High Efficiency	AirHandler	
All	Powder Free Antistatic Gloves	Laytex, Class M4.5	Microflex	Large 11-393-85A
		4.5" x 8.5"		

Area	Item	Description	Vendor	Model Number
All	Low-lint wipes	Cleaning Wipes	Kimwipes	34155

17.3 Acceptance Criteria

Acceptance criteria must be consistent with overall project technical and quality criteria. Some of the acceptance criteria are specifically detailed in 40 CFR Part 50. Other acceptance criteria such as observation of damage due to shipping can only be performed once the equipment has arrived on site.

Table 17.0.2 details the acceptance test and limits for procurement of supplies and consumables to be utilized in the PM_{2.5} LCAQMD network:

Table 17.0.2 Acceptance Criteria for Supplies and Consumables

Equipment	Acceptance Criteria	Action if Requirements not met
Impactor Oil	Is the oil identified as Tetramethyltetraphenyl-trisiloxane	Return
37 mm Glass Fiber Filter	Filters of the correct size and quality	Return
Rain Collector	Not broken	Call Vendor, will likely not return
O-Rings	Of the correct size	Return
In-line Filter	Of the correct size	Return
Battery	Correct size and voltage	Return
Fuses	Correct size and specification	Return
Floppy Disks	Undamaged and pre-formatted	Return
Filters, 46.2 mm Teflon	Tested and Accepted by the U.S. EPA with documentation of acceptance in package. Should meet visual inspection and pre-weight (110-160mg) criteria	Call David Lutz, U.S. EPA (919) 541-5476
Petri-dish	Clean and appropriately sized for 46.2 mm filters	Return
Filter Cassettes (single)	Of the correct type and make	Return
Filter Cassette Holder, Protective Containers	Of the correct size so that filter cassettes will not move around that could potentially lead to dislodging particulate	Return
Sequential Sampler Cassette Holder	Of the correct type for use with the sequential sampler model	Return
Filter Handling Containers	Clean	Clean
Anti-Static Solution	Of the correct type	Return
Static Control Strips	Manufactured within past 3 months and between 400 and 500 μCi of Polonium	Call vendor
Air Filters	Of the size and quality specified	Return
Powder Free Antistatic Gloves	Of the size and quality specified	Return

Equipment	Acceptance Criteria	Action if Requirements not met
Cleaning Wipes	Of the quality specified	Return

17.4 Tracking and Quality Verification of Supplies and Consumables

Tracking and quality verification of supplies and consumables have two main components. The first is the need of the end user of the supply or consumable to have an item of the required quality. The second need is for the purchasing department to accurately track goods received so that payment or credit of invoices can be approved. In order to address these two issues, the following procedures outline the proper tracking and documentation procedures to follow:

- Receiving personnel will perform a rudimentary inspection of the packages as they are received from the courier or shipping company. Note any obvious problems with a receiving shipment such as crushed box or wet cardboard.
- The package will be opened, inspected and contents compared against the packing slip.
- Supplies/consumable(s) will be compared to the acceptance criteria in Table 17.0.2.
- If there is a problem with the equipment/supplies received, the problem will be noted on the packing list, and the laboratory manager will be notified and the vendor called immediately.
- If the equipment/supplies appear to be complete and in good condition, sign and date the packing list and send to accounts payable so that payment can be made in a timely manner.
- Notify appropriate personnel that equipment/supplies have arrived and are available. For items such as the 46.2 mm Teflon filters, it is critical to notify the laboratory manager of the weighing room so sufficient time for conditioning of the filters can be allowed.
- Stock equipment/supplies in appropriate pre-determined area.

For supplies, consumables, and equipment used throughout the PM2.5 program, document when these items are changed out. If available, include all relevant information such as: model number, lot number, and serial number.

18.0 Data Acquisition Requirements

This Element addresses data not obtained by direct measurement from the PM2.5 Ambient Air Quality Monitoring Program. This includes both outside data and historical monitoring data. Non-monitoring data and historical monitoring data are used by the Program in a variety of ways. Use of information that fails to meet the necessary Data Quality Objectives (DQOs) for the PM2.5 Ambient Air Quality Monitoring Program can lead to erroneous trend reports and regulatory decision errors. The policies and procedures described in this element apply both to data acquired through the monitoring program and to information previously acquired and/or acquired from outside sources.

18.1 Acquisition of Non-Direct Measurement Data

The PM2.5 Ambient Air Quality Monitoring Program relies on data that are generated through field and laboratory operations; however, other significant data are obtained from sources outside the District or

from historical records. This Element lists these data and addresses quality issues related to the PM2.5 Ambient Air Quality Monitoring Program.

Chemical and Physical Properties Data

Chemical and physical and chemical properties data and conversion constants are often required in the processing of raw data into reporting units. This type of information that has not already been specified in the monitoring regulations will be obtained from nationally and internationally recognized sources. The following sources may be used in the PM2.5 Ambient Air Quality Monitoring Program without prior approval:

- National Institute of Standards and Technology (NIST)
- ISO, IUPAC, ANSI, and other widely-recognized national and international standards organizations
- U.S. EPA
- The current edition of certain standard handbooks may be used without prior approval. Two that are relevant to the fine particulate monitoring program are CRC Press' Handbook of Chemistry and Physics, and Lange's Handbook of Chemistry.

Geographic Location

Another type of data that will commonly be used in conjunction with the PM2.5 Ambient Air Quality Monitoring Program is geographic information. For the current PM2.5 site and other PM10 sites, the District will locate these sites using global positioning systems (GPS).

Historical Monitoring Information of the California ARB

Historical monitoring data and summary information is available from a network of ambient air monitoring stations, which have been in operation since the early 1980's. Information derived from that data may be used in conjunction with current monitoring results to calculate and report trends in pollutant concentrations. Direct comparisons of PM2.5 with historical TSP or PM10 data can be compared but will not be used to determine trends. Historical Dichot sampler data (coarse and fine portions) may be used to establish history or trends in PM2.5 concentrations and speciation (through XRF analysis) in the Geysers area (Glenbrook and Anderson Springs); however, evidence must be presented to demonstrate that results of the two methods are comparable.

External Monitoring Data Bases

It is the policy of the District that no data obtained from any other organization or agency shall be used in creating published reports or regulatory actions unless the data were collected under a QA program that meets the requirements of 40 CFR Part 58, and has been approved by the ARB. Exceptions do occur especially for short term, or specialty monitoring where standard practices are incorporated.

Data from the U.S. EPA AIRS data base may be used in published reports with appropriate caution. Care must be taken in reviewing/using any data that contain flags or data qualifiers. If data is flagged, such data shall not be utilized unless it is clear that the data still meets the District's QA/QC requirements. It is impossible to assure that a data base such as AIRS is completely free from errors including outliers and biases, so caution and skepticism is called for in comparing District data to that available in AIRS. Before use, the District reviews all available QA/QC information to assure that the data at least has a chance of being comparable with District protocol.

Speciated Particulate Data

Existing chemical speciation data for ions and for elements are very extensive. As noted above, speciation data (30 elements, by XRF analysis) from dichot and monochot samples have been obtained by the District for 2 monitoring locations in the Geysers since the early 1980's. These results may be used to provide a historical baseline for the speciation results to be obtained by the PM2.5 Ambient Air Quality Monitoring Program in that portion of Lake County; however, it is unclear whether the quality

of these data are sufficient to allow direct forward comparison with new data. Loading and sizing (monochots) are the primary issues in question.

Meteorological Data From Other Sources

Meteorological data are gathered from other sources such as the Geysers Air Monitoring Program (GAMP), U.C. Davis Integrated Pest Management (IPM) sites, Weather Information Network (WIN) sites and U.S. Weather Service sites to provide information required when developing monitoring sites, computing corrections needed to convert from standard conditions to local conditions, and to support analysis and modeling efforts. None of this site data is reported to AIRS and is identified when used in District studies or assessments.

19.0 Data Management

19.1 Background and Overview

This Element describes the data management operations pertaining to PM2.5 measurements for the PM2.5 station operated by the LCAQMD. This includes an overview of the mathematical operations and analyses performed on raw (“as-collected”) PM2.5 data. These operations include data recording, validation, transformation, transmittal, reduction, analysis, management, storage, and retrieval.

Data processing for PM2.5 data are summarized in Figure 19.0.1. Data processing steps for the PM2.5 program are integrated into the existing data processing system used for the District’s PM10 monitoring network. All sampling data will be entered into the District’s Laboratory Information Management System (LIMS) through a combination of manual entry and electronic transfer from the field. The LIMS data is stored on an Filemaker Pro database running on Mac G4 platform. All PM2.5 mass results will be hand entered into LIMS, where along with the field collected data, the final concentrations are calculated. The LIMS runs on the laboratory’s network and is accessible by all District staff. Appropriate security is assigned to each individual. This platform is shown in the upper left of Figure 19.0.1.

Each R&P sampler contains its own internal data logger. The data logger provide data collection for each station run as well as interval data collected continuously in 5-minute intervals. There is current no need to remotely acquire the PM2.5 sampler data, since filters need to be exchanged between runs.

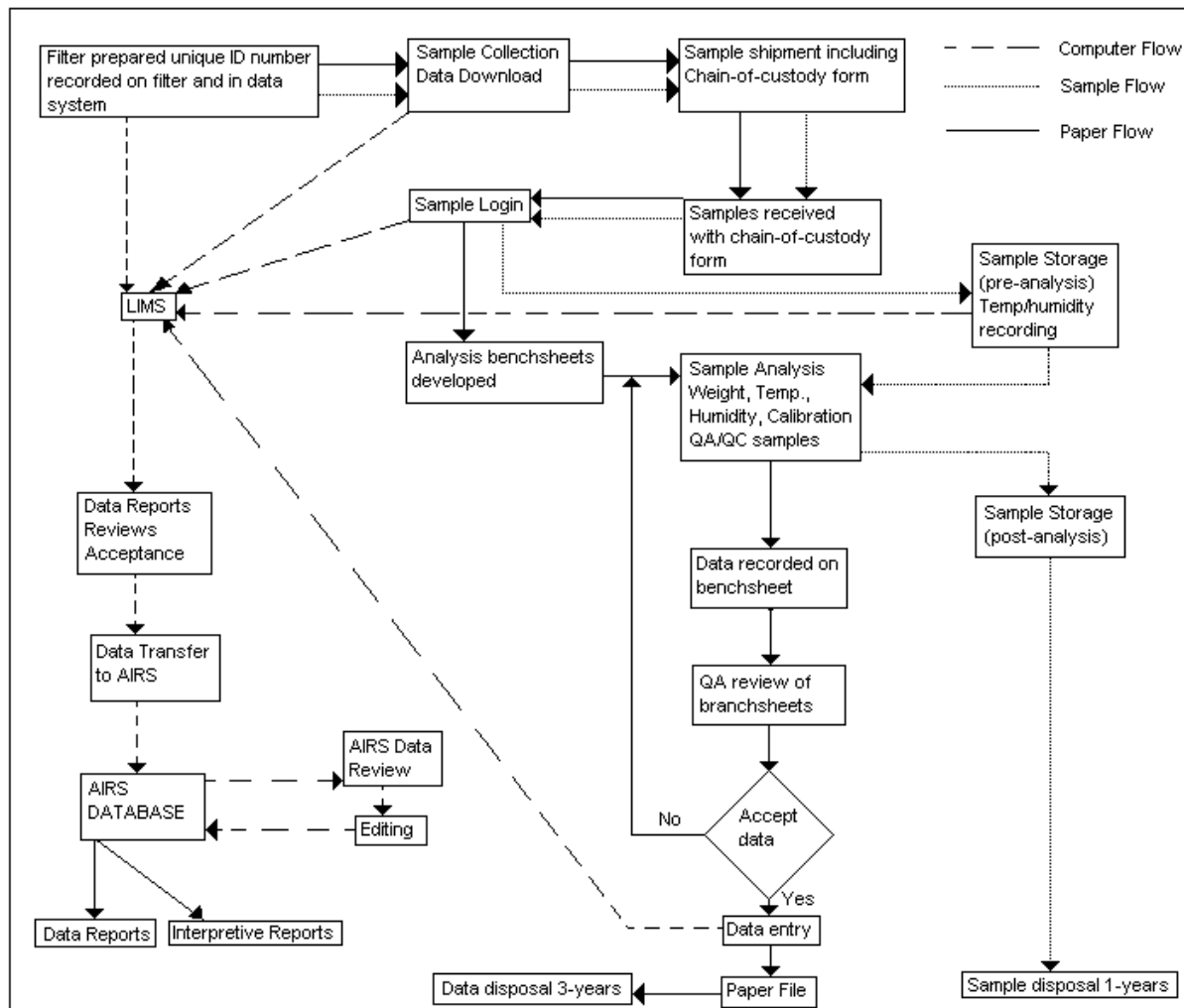
Filter tracking and chain of custody information is entered into the PM2.5 Field report form at four main stages as shown in Figure 19.0.1. Managers are able to obtain reports on status of samples, location of specific filters, etc. using this form.

There are two basic levels of access given to the monitoring database. Different privileges are given each authorized user depending on that person's need. The following privilege levels are defined:

- Data Entry Privilege** - The individual may enter, see and modify data within the PM2.5 LIMS. that he or she has personally entered. After a data set has been "committed" to the system by the data entry operator, all further changes will generate entries in the system audit trail. After the results are “approved” by management, only the Data Administrator can perform changes. The Data Administrator is responsible for performing the following tasks on a regular basis: merging/correcting the duplicate data entry files; running verification and validation routines and correcting data as necessary; generating summary data reports for management; and uploading verified/validated data to U.S. EPA AIRS.
- View and Reporting Privilege** - This privilege permits viewing and generation of data summary reports available under the FileMaker software. No data changes are allowed.

19.2 Data Recording

Data entry, validation, and verification functions are all integrated in the LIMS. Field data is entered electronically and laboratory data is entered manually by laboratory personnel. Procedures for filling



out the field and laboratory sheets and subsequent data entry are provided in SOPs listed in Appendix B.

19.3 Data Validation

Data validation involves checking that data processing operations have been carried out correctly and monitoring the quality of the field operations. Data validation can identify problems in either of these areas. Once problems are identified, the data can be corrected or invalidated, and corrective actions can be taken for field or laboratory operations. Numerical data stored in the LIMS are never internally overwritten by condition flags. Flags denoting error conditions or QA status are noted in the individual data record comment fields and saved in the data base, so that it is possible to recover any original data.

The following validation functions are incorporated into the LIMS to ensure quality of data entry and data processing operations:

- Duplicate Key Entry** - the following data are subjected to duplicate entry by different operators: filter weight reports, field data sheets, chain of custody sheets. The results of duplicate key entry are compared and errors are corrected at monthly or more frequent intervals.
- Range Checks** - almost all monitored parameters have simple range checks performed prior to finalizing entry. The data entry operator is notified immediately when an entry is out of range. The operator has the option reviewing hard copy records, electronically checking the run data and correcting the entry. The specific values used for range checks may vary depending on season and other factors. Since these range limits for data input are not regulatory requirements, they may be adjusted from time to time to better meet quality goals.
- Completeness Checks** - When the data are processed certain completeness criteria must be met. For example, each filter must have a start time, an end time, an average flow rate, dates weighed, and operator and technician names. The data entry operator will be notified if an incomplete record has been entered before the record can be closed.
- Internal Consistency and Other Checks** - Several other internal consistency checks are built into the system. For example, the end time of a filter must be greater than the start time. Computed filter volume (integrated flow) must be approximately equal to the exposure time multiplied by the nominal flow. Additional consistency and other checks will be implemented as the result of problems encountered during data screening.
- Data Retention** – Final output is printed on the back of the raw data sheets and are retained on file in the District office. Data sets are bound annually and stored into the balance room for a minimum of five years, and are readily available for audits and data verification activities. After five years, hardcopy records and computer backup media are cataloged and boxed for storage. Filters shall be discarded with appropriate attention to proper disposal of potentially hazardous materials.
- Statistical Data Checks** - Errors found during statistical screening will be traced back to original data entry files and to the raw data sheets, if necessary. These checks shall be performed for each sample and checked once again prior to any data submission to AIRS. Data validation is the process by which raw data are screened and assessed before it can be included in the District's Air Monitoring data base.
- Sample Batch Data Validation**- which is discussed in Element 23, associates flags that are generated by QC values outside of acceptance criteria, with a sample batch. Batches containing more than one flag may be rerun and/or invalidated.

Table 19.0.1 summarizes the validation checks applicable to LCAQMD PM2.5 data.

Table 19.0.1 Validation Check Summaries

Type of Data Check	Electronic Transmission and Storage	Manual Check	Automated Checks
Data Transmission Protocol Checks	yes	yes	
Duplicate Key Entry	yes	yes	
Date and Time Consistency	yes	yes	
Completeness of Required Fields	yes	yes	yes
Range Checking		yes	
Statistical Outlier Checking		yes	
Manual Inspection of Charts and Reports		yes	
Sample Batch Data Validation		yes	

Two key operational criteria for PM_{2.5} sampling are bias and precision. As defined in 40 CFR Part 58, Appendix A, these are based on differences between collocated sampler results and FRM performance evaluations. The District will review the results of collocated sampling during each collocated sample run. This data will be evaluated as early in the process as possible, so that potential operational problems can be addressed. The objective of the District is to optimize the performance of its PM_{2.5} monitoring equipment.

19.4 Data Transformation

Calculations for transforming raw data from measured units to final concentrations are relatively straightforward, and many are carried out in the sampler data processing unit before being recorded. The following relations in Table 19.0.2 pertain to PM_{2.5} monitoring:

Table 19.0.2 Raw Data Calculations

Parameter	Units	Type of Conversion	Equation
Filter Volume (V _a)	m ³	Calculated from average Flow Rate (Q _{ave}) in L/min, and total elapsed time (t) in min. multiplied by the unit conversion (m ³ /L)	See 40 CFR Part 58
Mass on Filter (M _{2.5})	ug	Calculated from post-weight (M _f) in mg and filter pre-weight (M _i) in mg, multiplied by the unit conversion (ug/mg)	See 40 CFR Part 58
PM _{2.5} Concentration (C _{PM2.5})	ug/ m ³	Calculated from laboratory data and sampler volume	See 40 CFR Part 58

19.5 Data Transmittal

Data transmittal occurs when data is transferred from one person or location to another or when data is copied from one form to another. Some examples of data transmittal are copying raw data from a notebook onto a data entry form for keying into a computer file and electronic transfer of data over a telephone or computer network. Table 19.0.3 summarizes data transfer operations.

Table 19.0.3 Data Transfer Operations

Description of Data Transfer	Originator	Recipient	QA Measures Applied
Keying Weighing Data into The LIMS	Laboratory Staff (hand-written data form)	Data Processing Staff	Double Key Entry
Electronic data transfer	(between PDA and Mac)	LIMS Computer	Parity Checking; transmission protocols
Filter Receiving and Chain-of-Custody	Lab Staff, Front Office Staff	The LIMS Computer Lab Log	Filter numbers are verified; reports indicate missing filters and/or incorrect data entries
AIRS data summaries	Data Administrator	AIRS (U.S. EPA)	ILS Manager

The ARB will report all PM_{2.5} ambient air quality data and information specified by the AIRS Users Guide (Volume II, Air Quality Data Coding, and Volume III, Air Quality Data Storage), coded in the AIRS-AQS format. Such air quality data and information will be fully screened and validated and will be submitted directly to EPA Region IX (Jim Forrest) for inclusion into AIRS-AQS via electronic transmission, in the format of the AIRS-AQS, and in accordance with the quarterly schedule. The specific quarterly reporting periods and due dates are shown in the Table 19.0.4.

Table 19.0.4 Data Reporting Schedule

Reporting Period	Due Date
January 1-March 31	June 30
April 1-June 30	September 30
July 1-September 30	December 31
October 1-December 31	March 31

19.6 Data Reduction

Data reduction processes involve aggregating and summarizing results so that they can be understood and interpreted in different ways. The PM_{2.5} monitoring regulations require certain summary data to be computed and reported regularly to U.S. EPA. Other data are reduced and reported for other purposes such as station maintenance. Examples of data summaries include:

- average PM_{2.5} concentration for a specific time period
- accuracy, bias, and precision statistics based on accumulated FRM/FEM data
- data completeness reports based on numbers of valid samples collected during a specified period

The Audit Trail is another important concept associated with data transformations and reductions. An audit trail is a data structure that provides documentation for changes made to a data set during processing. Typical reasons for data changes that would be recorded include the following:

- corrections of data input due to human error
- application of revised calibration factors
- addition of new or supplementary data
- flagging of data as suspect or invalid

The audit trail is implemented manually by the District. Audit trail records can include the following fields:

- operator's identity (ID code or initials)
- date and time of the change
- table and field names for the changed data item
- reason for the change
- full identifying information for the item changed (date, time, site location, parameter, etc.)
- value of the item before and after the change

Because of storage requirements, the Data Administrator must periodically move old records to backup or archive media (currently CD). Backups/Archives will be retained so information can be retrieved for at least three years.

19.7 Data Analysis

The District is currently running annual data summaries for the Lakeport PM_{2.5} site. It is anticipated that as the District's PM_{2.5} Monitoring Program develops, additional data analysis procedures will be developed. The following specific summary statistics will be tracked and reported for the PM_{2.5} network:

- Data completeness
- Minimum loading (ug/M³)
- Maximum loading (ug/M³)
- Average loading (ug/M³)

19.8 Data Flagging -Sample Qualifiers

A sample qualifier or a result qualifier consists of three or four alphanumeric characters which act as an indicator of the fact and the reason that the data value did not produce a numeric result, produced a numeric result but it is qualified in some respect relating to the type or validity of the result, or produced a numeric result but for administrative reasons is not to be reported outside the laboratory. Qualifiers will be used both in the field and in the laboratory to signify data that may be suspect due to contamination, special events, or an exceed of QC limits. Some flags will be generated by the sampling

instrument (see Table 6.0.2). Appendix C contains a complete list of the data qualifiers for the field and laboratory activities. Qualifiers will be placed on field and bench sheets with additional explanations in free form notes areas. Table 19.0.6 lists the sample batch flags that will be utilized.

Table 19.0.6 Sample Batch Quality Control Flags

Requirement	Acceptance Criteria	Flag
<i>Blanks</i>		
Field Blanks	± 30 ug difference	FFB
Lab Blanks	± 15 ug difference	9984
<i>Precision Checks</i>		
Laboratory Duplicate	± 15 ug	9984
<i>Accuracy</i>		
Balance Check	≤ 3 ug	9984

During the sample validation process, the flags will be used to decide on validating or invalidating individual samples or batches of data. Element 23 discusses this process.

There are several other flags associated with laboratory operations. See Appendix C for a complete list of data qualifiers/flags.

19.9 Data Tracking

The LIMS software contain the necessary input functions and reports necessary to track and account for the whereabouts of filters and the status of data processing operations for specific data. In combination with the Sample Report/Field Data Sheet filter location and status is recorded. The following tracking information is available:

- Filter lot
- Filter pre-sampling weighing (individual filter number first enters the system)
- Filter post-sampling weighing
- Filter archival
- Location of any filter (by filter number)
- List of deployed filters
- List of all returned filters, w/date of return, and have not been post-weighed
- List of all filters in the filter archive

The laboratory manager is responsible for tracking filter status weekly and following up on all anomalies.

19.10 Data and Filter Storage and Retrieval

Data and filter archive policies for the PM_{2.5} data are shown in Table 19.0.7.

Table 19.0.7 Data and Filter Archive Policies

Data Type	Medium	Location	Retention Time	Final Disposition
Weighing records; chain of custody forms	Hardcopy	LCAQMD Balance Room Laboratory	3 years	Discarded
Laboratory Notebooks	Hardcopy	LCAQMD Balance Room Laboratory	3 years	N/A
Field Notebooks	Hardcopy	Field Staff and/or Laboratory	3 years	Discarded
PM _{2.5} Data Base	Electronic	LCAQMD office	Annual, (electronic	Annual Archives

			backup monthly)	retained 5 years min
PM2.5 Calib./Audit records	Electronic & Hardcopy	LCAQMD office and Lab	3 years	Discarded
Filters	Filters	Laboratory	1 year (min)	Discarded

The PM2.5 data resides on a Mac G4 Cube computer in the District Engineer's office. The District's monitoring database includes all particulate monitoring data for the Lake County Air Basin including PM2.5 (Lakeport), and PM10 (Lakeport, Glenbrook, and Anderson Springs). The database is backed up monthly (CD) and archived annually (CD). The system is password protected which is applied by application software.

20.0 Assessments and Response Actions

An assessment, for this QAPP, is defined as an evaluation process used to measure the performance or effectiveness of the quality system, the establishment of the monitoring network and sites and various measurement phases of the data operation.

The results of quality assurance assessments indicate whether the control efforts are adequate or need to be improved. Documentation of all quality assurance and quality control efforts implemented during the data collection, analysis, and reporting phases is important to data users, who can then consider the impact of these control efforts on the data quality (see Element 21). Both qualitative and quantitative assessments of the effectiveness of these control efforts will identify those areas most likely to impact the data quality and to what extent. On the other hand, the selection and extent of the QA and QC activities used by a monitoring agency depend on a number of local factors such as the field and laboratory conditions, the objectives for monitoring, the level of the data quality needed, the expertise of assigned personnel, the cost of control procedures, pollutant concentration levels, etc.

In order to assure adequate performance, the District will conduct the following:

- Program Evaluations
- Network Review
- Field Performance Audits
- Laboratory Performance Audits
- Review of Data Quality Evaluations

20.1 Assessment Activities and Project Planning

20.1.1 Program Evaluation

A program evaluation is a qualitative assessment of the PM2.5 program focusing on the organization and overall results of the program. The evaluation can establish whether the prevailing quality management structure, policies, practices, and procedures are adequate for ensuring that good data can be obtained. LCAQMD's internal commitment to staffing, training, QA/QC, calibrations and audits, administrative reviews, data management and reporting, and implementation of corrective actions as necessary serve as a "living" program evaluation. The quality control and assessment activities that collectively represent the program evaluation uses the District's various SOP's and PM2.5 QAPP to determine the adequate operation of the PM2.5 program and its related quality system.

20.1.2 Network Review

An annual review is conducted by the LCAQMD to evaluate how well the existing program is meeting the District's air monitoring objectives, and how it should be modified to continue to meet its objective. A PM2.5 Network review will be accomplished every year. Proposed changes to the network (additional samplers/sites) will be considered during the network review.

The following categories will be emphasized during network reviews:

- Number of monitors
- Location of Monitors
- Siting Requirements
- Other, Modifications

In addition to the items included above, changes to the existing particulate monitoring network may eventually include conversion of existing FRM PM10 samplers to FRM PM2.5. This task could be easily accomplished through existing R&P 2.5 equipment at the District's laboratory parts storage facility.

20.1.3 Audits

Audits are a thorough and systematic qualitative evaluation, where the laboratory, equipment, staff, training, procedures, and record keeping are examined for conformance to the QAPP. District staff conducts internal audits consisting of:

- Field - handling, sampling
- Laboratory – Pre sampling weighing, post sampling weighing, archiving, and associated QA/QC
- Data Management - Information collection, flagging, data editing, security, upload

Field and laboratory performance evaluations reveal how the data are handled, what judgments were made, and whether uncorrected mistakes were made. The reviews can often identify the means to correct systematic data reduction errors. These reviews are conducted throughout the year in preparation of ARB/EPA audits. Planning, field operations, laboratory operations, QA/QC, data management, and reporting are all evaluated for deficiencies. Any deficiencies which cannot be immediately corrected or if modifications to procedures are warranted, ARB will be consulted and changes will be made to the District's SOP.

20.1.4 Review of Data Quality Assessments

A data quality assessment (DQA) are performed routinely on all statewide programs by the ARB. They entail a statistical analysis of the PM2.5 data to determine whether the quality of data is adequate to support the decisions which are based on the DQOs. Data are appropriate if the level of uncertainty in a decision based on the data is acceptable.

These functions are done on an annual basis as required under 40 CFR Part 58. Data are processed through data screening programs to determine if they are suitable for use in attainment/non attainment decisions. Data flagged during this procedure are subject to further evaluation using statistical techniques to determine possible causes of anomalies. Results of these analyses are forwarded to data collection staff for confirmation of validity or non validity of data. If the data are shown to be invalid, Air Quality Data Review Section staff will remove the data from all relevant databases. All changes to the data are to be documented in air quality data action reports. The District reviews data decisions to insure the LCAQMD attainment status is maintained.

21.0 Reports to Management

This Element describes the quality-related reports and communications to management in support of the District's PM2.5 network operations and the associated data acquisition, validation, assessment, and reporting. Unless otherwise indicated, data pertaining to PM2.5 will be included in reports containing monitoring data for other pollutants.

Important benefits of regular QA reports to management include the opportunity to alert the management of data quality problems, to propose viable solutions to problems, and to procure necessary additional resources. Quality assessment, including the evaluation of the technical systems, the measurement of performance, and the assessment of data, is conducted to ensure that measurement results meet program objectives and that necessary corrective actions are taken early, when they will be most effective. This is particularly important in the PM_{2.5} network, as new equipment and procedures are being implemented.

Effective communication among all personnel is an integral part of a quality system. Regular, planned quality reporting provides a means for tracking the following:

- adherence to scheduled delivery of data and reports,
- documentation of deviations, and the impact of these deviations on data quality
- analysis of the potential uncertainties in decisions based on the data

21.1 Frequency, Content, and Distribution of Reports

Reports to management for the District's PM_{2.5} monitoring program in general are made in conjunction with the quarterly QA/QC reports to the ARB. These reports are described in the following sub elements.

21.1.1 Network Reviews

Upon any changes to the monitoring network, the District will provide a detailed description including all applicable AIRS coding to the ARB and U.S. EPA Region IX Office, with a copy to the Aerometric Information Retrieval System (AIRS)-Air Quality Subsystem (AQS). The AIRS-AQS is U.S. EPA's computerized system for storing and reporting of information relating to ambient air quality data.

21.1.2 Quarterly Reports

Each quarter, the District will report to EPA Region IX Office / AIRS-AQS the results of all monitoring activities carried out during the quarter. The quarterly submittals will be consistent with the data reporting requirements specified for air quality data as set forth by EPA Region IX. Air quality data submitted for each reporting period will be edited, validated, and entered into the AIRS-AQS using the procedures described in the *AIRS Users Guide, Volume II, Air Quality Data Coding*. The

21.1.3 System Audit Reports

The District will make available all internal audits, calibrations, ARB audit results, EPA audit results to District management and the interested public. Written reports will be filed and maintained in the laboratory balance room records section.

21.1.4 Air Quality Data Action Request

An Air Quality Data Action (AQDA) request is issued by the ARB whenever a problem is found such as an operational problem, or a failure to comply with procedures, which could have an effect on data quality. The AQDA request is one of the most important ongoing reports to management because it documents primary QA activities and provides valuable records of QA activities that can be used in preparing other summary reports.

The AQDA request procedure is designed as a closed-loop system. The AQDA request form identifies the originator, who reported and identified the problem, states the problem, and may suggest a solution. The form also indicates the name of the person(s) who is assigned to correct the problem. The assignment of personnel to address the problem and the schedule for completion will be filled in by the appropriate supervisor. The AQDA request procedure closes the loop by requiring that the recipient state

on the form how the problem was resolved and what disposition to take with the data (accept, correct, invalidate). Copies of the AQDA request will be distributed twice: first, when the problem has been identified and the action has been scheduled; and second, when the correction has been completed. The ARB and the District will be included in both distributions.

21.1.5 Laboratory Quality Control Summary

The District will provide quarterly reports summarizing the laboratory quality control to the Quality Assurance Section of the ARB. The report will include summaries for replicate measurements, microbalance statistics, balance room statistics, lab and field blank statistics, and laboratory relative humidity and temperature calibration information.

21.2 Responsible Organizations

This element outlines the responsibilities of individuals within the monitoring organization for preparing quality reports, evaluating their impact, and implementing follow-up actions. Changes made in one area or procedure may affect another part of the project. Only by defining clear-cut lines of communication and responsibility can all the affected elements of the monitoring network remain current with such changes. The documentation for all changes will be maintained and included in the reports to management. The following paragraphs describe key personnel involved with QA reporting.

Air Pollution Control Officer / Director of the Lake County Air Quality Management District

The ultimate responsibility for the quality of the data and the technical operation of the the District's PM2.5 program rests with the APCO. The APCO's responsibilities with respect to air quality reporting are delegated to the Deputy APCO, Air Quality Engineer, and Air Quality Specialist. These responsibilities include defining and implementing the document management and quality assurance systems for the District's PM2.5 monitoring program.

Deputy Air Pollution Control Officer

The Deputy APCO is ultimately responsible for the data collected from all PM2.5 monitors in the District's monitoring network. The DAPCO is responsible for evaluating the quality assurance and quality control programs to ensure the highest quality data that is feasible, assessing the acceptability of the air quality data prior to its use in the regulatory process, and developing and implementing tighter quality control measures as needed. Also provides expert technical support for the District's Air Quality Monitoring Program. The DAPCO delegates responsibility for the collection, validation, and submission of the data collected from the PM2.5 program, and responsibility for the submittal of all relevant reports to the Air Quality Engineer and Air Quality Specialist.

Air Quality Engineer

The Air Quality Engineer provides accurate ambient air monitoring data measurements to define the nature extent and trend of air quality within Lake County. The AQE maintains responsibility for the proper operation, maintenance, and repair of the PM2.5 monitors, balance room laboratory and the data collection. He also maintains the responsibility to maintain a supply of spare parts for the laboratory and PM2.5 monitors. He conducts and reviews quality assurance, quality assessment, and quality control activities for the program. He submits all relevant reports to the ARB and/or EPA.

Air Quality Specialist

Field technicians are normally responsible for the preparation of reports, field activities including filter exchanges, data recovery, maintenance, and instrument calibrations. Currently this position is vacant. The AQE is currently performing the duties of this position.

22.0 Data Review, Validation and Verification Requirements

This element describes how the District will verify and validate the data collection operations associated with the PM_{2.5} ambient air monitoring program for Lake County. Verification can be defined as confirmation by examination and provision of objective evidence that specified requirements have been fulfilled. Validation can be defined as confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use are fulfilled. Although there are a number of objectives of ambient air data, the major objective for the District's PM_{2.5} program is for comparison to the NAAQS standard and therefore, this will be identified as the intended use. This element will describe the verification and validation activities that occur at a number of the important data collection phases. Earlier elements of this QAPP describe in detail how the activities in these data collection phases will be implemented to meet the data quality objectives of the program. Review and approval of this QAPP by the ARB and U.S. EPA Region IX provide initial agreement that the processes described in the QAPP, if implemented, will provide data of adequate quality. In order to verify and validate the phases of the data collection operation, the District will use various qualitative assessments to verify that the QAPP is being followed, and will rely on the various quality control samples, inserted at various phases of the data collection operation, to validate that the data will meet the DQOs described in Element 7.

22.1 Sampling Design

The "2001 California PM_{2.5} Monitoring Network Description", published August of 2001, describes the sampling design and operation for the PM_{2.5} network established by the ARB. It covers the number of sites required, their location, and the frequency of data collection. The objective of the sampling design is to represent the population of interest at adequate levels of spatial and temporal resolution. Most of these requirements have been described in the Code of Federal Regulations. However, it is the responsibility of the District to ensure that the intent of the regulations are properly administered and carried out in Lake County.

Verification

Verification of the sampling design occurs through three processes. The Network Design Plan that discusses the initial deployment of the network was submitted, reviewed and approved by U.S. EPA Region IX prior to implementation. This process verified the initial sampling design. An annual review (by the ARB) is performed to determine whether the network objectives are being met, and that the site meets the CFR siting criteria. In addition to the above, every three years the U.S. EPA Region IX Office conducts a network review to determine whether the network objectives, as described in the Network Design Plan, are still being met, and that the sites are meeting the CFR siting criteria.

Validation

The ambient air data derived from the sites will be used to validate the sampling design. This information will be included in network review documentation and appropriately communicated to the U.S. EPA Region IX Office. In addition, the processes described in Element 10 will be used to confirm the network design.

22.2 Sample Collection Procedures

Sample collection procedures are described in detail in Element 11 and were developed to ensure proper sampling and to maintain sample integrity.

Verification

Audit (system, internal) will be used to verify the sampling collection activities. State and federal audits are also conducted to verify the sampling collection activities. System audits will be used to verify that the sample collection activity is being performed as described in this QAPP and the SOPs. Deviations from the sample collection activity will be noted and corrected using the procedures described in Element 20.

Validation

The sample collection activity is just one phase of the measurement process. The use of QC samples, replicate measurements, flow checks, laboratory and field blanks that have been placed throughout the measurement process can help validate the activities occurring at each phase. The review of QC data such as the collocated sampling data, field blanks, the FRM performance evaluation, and the sampling equipment verification checks that are described in Elements 14 and 16 can be used to validate the data collection activities. Any data that indicates unacceptable levels of bias or precision will be flagged and investigated.

22.3 Sample Handling

Elements 11, 12, and 17 provide the requirements for sample handling, including the types of sample containers and the preservation methods used to ensure that they are appropriate to the nature of the sample and the type of data generated from the sample. Due to the size of the filters, loading characteristics, and the nature of the collected particles, sample handling is one of the phases where bad technique can result in a significant effect on sample and data quality.

Verification

As mentioned above, various audits and evaluations will be conducted to assure the specifications outlined in the QAPP are followed. The reviews will include checks on the identity of the sample (e.g., proper labeling and chain-of-custody records), packaging in the field, and proper storage conditions (e.g., chain-of-custody and storage records) to ensure that the sample continues to be representative of its native environment as it moves through the data collection operation.

Validation

Similar to the validation of sampling activities, the review of data from collocated sampling, field blanks, and the FRM performance evaluations, that are described in Elements 14 and 16, can be used to validate the sample handling activities. Acceptable precision and bias in these samples would lead one to believe that the sample handling activities are adequate. Any data that indicates unacceptable levels of bias or precision will be flagged and investigated.

22.4 Analytical Procedures

Element 13 details the requirements for the analytical methods, which include the pre-sampling weighing activities that give each sample a unique identification, an initial weight, and prepares the sample for the field, and the post-sampling weighing activities, which provide the mass net weight and the final concentration calculations. The methods include acceptance criteria (Elements 13 and 14) for important components of the procedures, along with suitable codes to note deviation from the procedure.

Verification

As mentioned above, system audits will be performed to ensure the analytical method specifications mentioned in the QAPP are being followed. The audits will include checks on the identity of the sample. Deviations from the analytical procedures will be noted and corrected using the procedures described in Element 20.

Validation

Similar to the validation of sampling activities, the review of data from lab blanks, calibration checks, laboratory duplicates and other laboratory QC that are described in Elements 14 and 16 can be used to validate the analytical procedures. Acceptable precision and bias in these samples would lead one to believe that the analytical procedures are adequate. Any data that indicates unacceptable levels of bias or precision will be flagged and investigated as described in Element 14.

22.5 Quality Control

Elements 14 and 16 of this QAPP specify the various QC checks that are to be performed during sample collection, handling, and analysis. These include analyses of check standards, blanks, and replicates, which provide indications of the quality of data being produced by specified components of the measurement process. For each evaluation check, the procedure, acceptance criteria, and corrective action are specified.

Verification

As mentioned above, various system evaluations will be performed to ensure the quality control method specifications mentioned in the QAPP are being followed.

Validation

Validation activities of many of the other data collection phases mentioned in this section use the quality control data to validate the proper and adequate implementation of that phase. Similarly, validation of QC procedures will require a review of the documentation of the corrective actions that were taken when QC samples failed to meet the acceptance criteria, and the potential effect of the corrective actions on the validity of the routine data. Element 14 describes the techniques used to document QC review/corrective action activities.

22.6 Calibration

Element 16, as well as the field (Element 11) and the analytical elements (Element 13) detail the calibration activities and requirements for the PM2.5 program.

Verification

As previously mentioned, system audits will be performed to ensure the calibration specifications and corrective actions mentioned in the QAPP are followed. Deviations from the calibration procedures will be noted and corrected using the procedures described in Element 20.

Validation

Similar to the validation of sampling activities, the review of calibration data that are described in Elements 14 and 16, can be used to validate the calibration procedures. Calibration data within the acceptance requirements shows that the sample collection measurement devices are operating properly. Any data that indicates unacceptable levels of bias or precision will be flagged and investigated as described in Elements 14 or 16, and corrected as appropriate. Validation would include the review of the documentation to ensure corrective action was taken as prescribed in the QAPP.

22.7 Data Reduction and Processing

Verification

As mentioned above, system audits will be performed to ensure the data reduction and processing activities outlined in the QAPP are being followed.

Validation

As part of the routine audits of data quality, discussed in Element 20, a number of samples are selected. All raw data files, including the following will be reviewed:

- Pre-sampling weighing activity
- Pre-sampling activities and environment
- Sampling activity and sampler download data
- Sampler calibration in effect during sampling period
- Post-sampling handling, storage, and transport to lab
- Post-sampling storage and weighing by lab
- Corrective action procedures
- Data reduction and entry

This raw data will be reviewed and final concentrations will be calculated by hand to determine if the final values submitted to AIRS compare to the hand calculations. The data will also be reviewed to ensure that associated flags or any other data qualifiers have been appropriately associated with the data and that appropriate corrective actions were taken. This validation is routinely performed quarterly prior to data submittal for AIRS.

23.0 Validation and Verification Methods

Many of the processes for verifying and validating the measurement phases of the PM_{2.5} program have been discussed in Element 22. If these processes, as written in this QAPP are followed and the monitoring site is representative for the conditions for which it was selected, one would expect to achieve the intended PM_{2.5} Data Quality Objectives. Exceptional field events may occur, however, and field and laboratory activities may adversely affect the integrity of the samples. Additionally, it is expected that some of the QC checks will fail to meet the acceptance criteria. Information on problems that affect the integrity of the data are identified in the form of data qualifiers or flags. It is important to determine how and whether or not these problems affect the routine data. The review of the routine data and their associated QC data will be verified and validated. It is assumed that if measurement uncertainty will be maintained within the precision and bias DQOs.

23.1 Process for Validating and Verifying Data

23.1.1 Verification of Samples

After a sample batch is processed in the laboratory, a thorough review of the data for completeness and data entry accuracy will be performed. All raw data that are entered by hand on the data sheets will be compared to the electronic data as discussed in Element 19. The data is compared to insure each site is correctly represented. Data that fall outside the acceptance criteria will then be flagged. The flagged data will be reviewed and reassessed. Details of these activities are discussed in Element 19. The data qualifiers or flags are listed in Appendix C.

23.1.2 Validation

Validation of measurement data will be conducted on three levels: one at the measurement value level, a second at the batch level, and a third at the instrument level. Records of all invalid samples will be filed. Information will include a brief summary of the reason(s) for invalidating the sample along with the associated flags. A portion of this record will be available on the data sheet since filters that are pre-weighed will be recorded regardless of sample validity. Every invalidated sample will have at least one flag. Additional flags will be tagged on as appropriate to better explain the characteristics of the invalid sample. Notes in the Comment field can/will also be included.

Measurement Values

Certain criteria based upon Title 40 CFR, EPA Guidance Document 2.12, and field operator and laboratory technician judgment have been developed that will be used to determine whether individual samples or samples from a particular instrument will be invalidated. In all cases the samples will be returned to the laboratory for further examination. When the laboratory staff reviews the field data sheet, he or she will look for flagged values. Samples that are flagged for obvious contamination, filter damage, or field accidents be examined immediately. Upon concurrence of the laboratory technician and lab manager, these samples will be invalidated.

The flags listed in Appendix C may be used alone or in combination to invalidate samples. Since the possible flag combination cannot be anticipated, the District review all events on a case by case basis. The combinations will be tracked and reported to ARB and EPA, and will be used to insure the District is consistent in its evaluation approach. All data invalidation will be fully documented. Table 23-1 contains criteria for single sample invalidation.

Table 23-1 Single Flag Criteria

Requirement	Flag	Determination
Contamination	9977	Concurrence of lab technician and lab manager
Filter Damage	9976	Concurrence of lab technician and lab manager
Unusual Event	See UE Table	Verification of UE, Concurrence of lab technician and lab manager
Lab Accident	9984	Concurrence of lab technician and lab manager
Field Accident	9976	Concurrence of lab technician and lab manager
Flow rate error	9974	Termination of sampling, Instrument cut-off

Due to the nature and turn-around times of samples, it is important that the District minimize the amount of data invalidated. Therefore, the District will validate data on single samples. Based on the types of QC, samples that are included and the field and laboratory conditions that are reported (flags), the ARB, in conjunction with the national PM_{2.5} Data Validation Workgroup, is developing a validation template that will be used to determine when routine data will be invalidated and when major corrective actions need to be instituted. Tables 23-2, 23-3, and 23-4 illustrate the validation template.

Table 23-2 lists those requirements which are critical and must be met. Table 23-3 lists the recommendations that should be met. In cases where the acceptance criteria in Table 23-3 are not met, the District will investigate and take corrective action. Data failing to meet this criteria will not necessarily be invalidated. Table 23-4 lists those requirements that should also be met but are of a systemic nature. Data will not necessarily be invalidated if the criteria in Table 23-4 are not met.

Table 23-2 Critical Frequency and Acceptance Criteria

Requirement	Frequency	Acceptance Criteria
<i>Filter Holding Time</i>		
Post Sampling weighing	All filters	< 10 days at 25°C from sample end date
<i>Sampling Period</i>	All Filters	1380 – 1500 minutes or if <1380 and an exceed of the AAQS
<i>Sampling Instrument</i>	Every 24 hrs op	<= 5% of 16.67 lpm
Flow rate	“	<= 2% CV
	“	no flow excursions > 5% for > 5 min
<i>Filter</i>		
Visual defect check	All filters	No defects per QA G..Doc 2.12, Sec 7.5
Filter Cond, Environment	All filters	24 hr min
Equilibration	“	24 hr mean 20-23°C
Temp. Range	“	+/-2°C std.dev. over 24 hrs
Temp. Control	“	24 hr mean 30-40% or +/- sampling RH >20%
Hum. Range	“	+/-5% std.dev. over 24 hrs
Hum Control	“	+/-5% RH
Pre/post Sampling RH	“	located in filter conditioning environment
Balance	“	

Table 23-3 Operational Indicators

Requirement	Frequency	Acceptance Criteria
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<i>Reporting Units</i>	All Samples	ug/M ³
Detection Limit		
Lower	All Samples	2 ug/M ³
Upper	All Samples	200 ug/M ³
<i>Filter Holding Time</i>		
Pre Sampling	All filters	< 30 days before sampling
Filter Checks		
Lot Blanks	3 per lot	< 15 ug change between weighings
Exposure Lot Blanks	3 per lot	< 15 ug change between weighings
<i>Lab QC Checks</i>		
Field Filter Blank	10% or 1 per weighing	+/- 30 ug change between weighings
Lab Filter Blank	10% or 1 per weighing	+/- 15 ug change between weighings
Balance Check	start and every 10 th	>= 3 ug
Duplicate weighing	1 per weighing	+/-15 ug change between weighings
<i>Sampler</i>		
Filter Temp Sensor	Every 24 hrs of op	< 5 °C of ambient for < 30 min
<i>Calibration/Verification</i>		
Multi-point calib.	2/yr or if 1-pt fails	+/- 2% xfer std.
Single-point check	1/4 weeks	+/- 2% xfer std. and +/- 2% of design FR
Ext. Leak Check	every 5 samples	< 80 ml/min
Int. Leak Check	every 5 samples	, 80 ml/min

Table 23-4 Systematic Issues

Requirement	Frequency	Acceptance Criteria
<i>Data Completeness</i>	quarterly	75%
<i>Accuracy</i>		
FRM Performance Eval.	4/yr	+/- 10%
<i>Precision</i>		
Single Analyzer	1/3 months	CV <=10%
Single Analyzer	1/yr	CV <=10%
Reporting Org.	1/3 months	CV <=10%
<i>Calibration Standards</i>		
Gilian	1/yr	+/- 2% of NIST traceable std.

The samples will be evaluated and a report will be generated based on the results of validation. Those samples which have been invalidated, those samples will be reanalyzed and reevaluated. All efforts will be made to implement all corrective actions necessary to correct any problem or deficiency. If after this second review and evaluation the sample(s) still remain outside the applicable criteria, they will be flagged as invalid, depending on the specific acceptance criteria. Each quarter a summary report of all data that were invalidated along with explanations, will be submitted to the ARB and EPA Region IX.

References

EPA (1997a) National Ambient Air Quality Standards for Particulate Matter Final Rule, 40 CFR Part 50. Federal Register, 62(138):38651-38760, July 18, 1997.

EPA 1997b. Ambient air monitoring reference and equivalent methods. U.S. Environmental Protection Agency. 40 CFR Part 53, as amended July 18, 1997

EPA 1997. Reference method for the determination of fine particulate matter as PM in the 2.5 atmosphere. U.S. Environmental Protection Agency. 40 CFR Part 58, Appendix L, as amended July 18, 1997.

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WeatherMeasure Weathertronics 1984 Model 5231 Operating Manual Rev. A, January 1984

QAPP Appendix A

Acronyms and Abbreviations

AIRS	Aerometric Information Retrieval System
AMTAC	Air Monitoring Technical Advisory Committee
ANSI	American National Standards Institute
APCO	Air Pollution Control Officer
APTI	Air Pollution Training Institute
AQDAS	Air Quality Data Acquisition System
AQDB	Air Quality Data Branch
AQDRS	Air Quality Data Review Section
AQE	Air Quality Engineer
AQM-C	Air Quality Monitoring - Central
AQM-N&OS	Air Quality Monitoring - North and Operations Support
AQM-S	Air Quality Monitoring - South
AQOT	Air Quality Office Technician
AQS	Air Quality Specialist
AQSB	Air Quality Surveillance Branch
ARB	Air Resources Board
ASTM	American Society for Testing and Materials
AWMA	Air and Waste Management Association
CAA	Clean Air Act
CFR	Code of Federal Regulations
DAPCO	Deputy Air Pollution Control Officer
DAS	data acquisition system
DQA	data quality assessment
DQOs	data quality objectives
ELB	Engineering and Laboratory Branch
EMAD	Emissions, Monitoring, and Analysis Division
FEM	Federal equivalent method
FEPS	Federal Information Processing Standards
FRM	Federal reference method
GIS	geographical information systems
GLP	good laboratory practice
GPS	Global Positioning System
HVAC	heating ventilation and air conditioning
ILS	Inorganic Laboratory Section
LCAQMD	Lake County Air Quality Management District
LIMS	laboratory information management system
LPM	liters per minute
MLD	Monitoring and Laboratory Division
MOU	Memorandum of Understanding
MQAG	Monitoring and Quality Assurance Group
MQOs	measurement quality objectives
NAAQS	National Ambient Air Quality Standards
NAMS	national air monitoring station
NIST	National Institute of Standards and Technology
NPAP	National Performance Audit Program
OAQPS	Office of Air Quality Planning and Standards
OARM	Office of Administration and Resources Management
ORD	Office of Research and Development
PAMS	Photochemical Assessment Monitoring Stations
PE&S	Program Evaluation and Standards
PM2.5	particulate matter \leq 2.5 Microns

POC	pollutant occurrence code
PTFE	polytetrafluoroethylene
Q_a	flow rate at ambient (actual) conditions of temp. & pres.
QA	Quality assurance
QA/QC	Quality assurance/quality control
QAAR	quality assurance annual report
QAPP	quality assurance project plan
QAS	Quality Assurance Section
QMOSB	Quality Management and Operations Support Branch
QMP	quality management plan
R&P	Rupprecht & Patashnick
SA	System audit
SIPs	State Implementation Plans
SLAMS	state and local air monitoring stations
SOP	Standard Operating Procedure
SPM&DS	Special Purpose Monitoring and Data Support
SPMS	special purpose monitoring stations
T_a	Temperature, ambient or actual
TSD	Technical Support Division
TSP	total suspended particulate
U.S. EPA	United States Environmental Protection Agency
V_a	air volume, at ambient or actual conditions
VOC	volatile organic compound
WAM	Work Assignment Manager
WIN	Weather Information Network

QAPP Appendix B

LAKE COUNTY AIR QUALITY MANAGEMENT DISTRICT Standard Operating Procedure For The PM_{10/2.5} Mass Analysis Program

Summary of Method

This document describes the methodology used by District staff to analyze the mass of PM_{10/2.5} samples collected on 47mm Teflon filters. Individual Teflon filters (46.2 mm in diameter) are weighed on an electronic microbalance before and after field sampling. Particulate matter (less than 10/2.5 μ m in diameter) is collected from ambient air over a 24-hour period. The net difference between pre and post sampling filter weights is used to calculate the ambient air mass concentration. After post-weighing, the filters are stored for subsequent analysis.

Interference's

- a. The potential effect of body moisture or oils contacting the filters is minimized by using non-serrated forceps to handle the filters at all times. This measure also moderates interference due to static electricity.
- b. Teflon filters accumulate a surface electrical charge, which may affect filter weight. Static electricity is controlled by treating filters with a "Static Master" static charge neutralizer prior to weighing. Placement of filters on a "Static Master" unit is required for a minimum 30 seconds before the filter is weighed.
- c. Moisture content can affect filter weight. Filters are equilibrated for a minimum of 24 hours in a controlled environment prior to pre- and post-weighing. During the equilibration period, relative humidity within the balance room is maintained at a mean value range of 30-40% and air temperature is maintained at a mean value range of 21-23°C.
- d. Airborne particulate can adversely affect accurate mass measurement of the filter. Filters undergoing conditioning should not be placed within an airflow path created by air conditioning ductwork, in close proximity to computer printers, or be subjected to ambient air turbulence created by frequently opened doorways. Cleaning laboratory bench-tops can further minimize dust contamination and weighing areas daily, installing "sticky" floor mats at doorway entrances to the balance room and wearing clean lab coats over regular clothing.

Apparatus

- a. Cahn Model C-32 electronic microbalance with a minimum resolution of 0.0001 mg (i.e., 0.1 microgram) and a precision of +/- 0.001 mg, supplied with a balance pan. The microbalance is positioned on a vibration-damping balance support table.
- b. Calibration weights, (100, and 200 μ g) utilized, as Mass Reference Standards are certified as traceable to NIST mass standards. Two sets are utilized, one set as a working standard and one set as the primary standard. The weights are ASTM E617-91 Class 1.1 category.
- c. One Radioactive (alpha particle) Polonium-210 (Static Master) anti-static strip is used for static charge neutralization.
- d. Non-metallic, non-serrated forceps.
- e. Digital timer/clock.

- f. Filters; Teflon membrane; 46.2 mm in diameter with a polypropylene support ring.
- g. Filter support cassettes.
- h. Filter conditioning cabinet.
- i. Dickson Relative Humidity/Temperature Recorder, Davis Instruments Weather Monitor II Temperature and Relative Humidity sensor/logger.
- j. Assmann Psychrometer (NIST-certified) for calibration of instruments measuring relative humidity.
- k. Precision thermometer (NIST certified No. 263364-00, 213426) for calibration of instruments measuring temperature.
- l. Dust-free latex gloves.
- m. Plastic petri-slide filter containers
- n. Zip-lock plastic bags.
- o. Disposable laboratory wipes.
- p. Insulated metal filter carrying cases (R&P).

Calibration Procedure

Prior to any filter weighing session, the microbalance is calibrated. First, the microbalance base is checked for level and adjusted as needed. The microbalance should be on, and the display should read "0.000". To ensure maximum stability, the microbalance is left on at all times. If needed, the range of the microbalance should be adjusted to the "Range B", which corresponds to the 250-1 ug scale by pressing the "Range" key. To protect the sensitive microbalance pan from air turbulence, the draft shield door should remain closed when not loading or unloading the balance.

Microbalance External Calibration Check: Open the draft shield door to allow equilibration to room temperature. After equilibration has been reached (usually within one minute), close the draft shield door. Press the "TARE" key to ensure zero-readout. The display should read "0.000" (The balance zero is rechecked every tenth filter, and a post run zero check is performed at the end of every weigh session - tolerance of +/- 3 ug is allowed). Open the draft shield door. Place a 200-mg working reference standard calibration weight onto the microbalance pan with non-metallic forceps. Close the draft shield door. Record the date, time, temperature, relative humidity, and mass readout in the quality control logbook. If the balance is out of calibration (does not show 200.000 mg), reset the display by pressing the "Cal" key. Record the final mass readout in the logbook. Remove the calibration weight and tare the microbalance as described above. Place a 100-mg working reference standard calibration weight onto the microbalance pan with non-metallic forceps. Close the draft shield door. Record the mass readout in the quality control logbook. An external calibration must be performed daily for each day that filters are pre- or post-weighed, and the 200 mg calibration is rechecked every tenth filter, and a post run cal is performed at the end of every weigh session. A tolerance of +/- 3 ug is allowed.

Temperature/RH The temperature and relative humidity monitoring equipment (Dickson Relative Humidity/Temperature Recorder, Davis Instruments Weather Monitor II Temperature and Relative Humidity sensor/logger) will be calibrated on a quarterly schedule. The quarterly calibrations will be supplemented by monthly calibration checks. Calibration values will be provided by: an Assmann Psychrometer (NIST-certified) for calibration of instruments measuring relative humidity; and a Precision thermometer (NIST certified No. 263364-00, 213426) for calibration of instruments measuring temperature.

Filter Inspection and Equilibration

When new filters are initially brought into the laboratory for pre-conditioning and pre-weighing, they should be transferred from the sealed manufacturer's packaging to a filter-handling container such as a plastic petri-slide. The filters should be handled only with non-serrated forceps. Gloves which are free of contaminant ions, powder-free and anti-static may be worn by lab staff when filters are being prepared for conditioning and weighing. Before any filter is used, it must be inspected for defects. This

is done by an examination of the filter in front of a light source. Filters are discarded if any of the following defects are identified:

1. Pinhole—A small hole appearing as a distinct and obvious bright point of light when examined in front of a light source.
2. Separation of ring—Any separation or lack of seal between the filter and the filter support ring.
3. Chaff or flashing—Any extra material on the reinforcing ring or on the heat-seal area that would prevent an airtight seal during sampling.
4. Loose material—Any extra loose material or dirt particles on the filter.
5. Discoloration—Any discoloration that might be evidence of contamination.
6. Other—A filter with any imperfection not described above, such as irregular surfaces or other results of poor workmanship.

From each new lot of filters, a random sample of 3 filters (lot blanks) are placed in separate containers in the balance room. The “lot blanks” are weighed every 24 hours. The filters should be conditioned in an open sided cabinet that allows air circulation over the filters while reducing the risk of extraneous airborne particles inside the balance room settling on the filters. If the weight change after 24 hours exceeds 15 ug, continue conditioning until the weight variation is <15 ug for each of the “lot blank” filters. The lot number (inscribed on the filter packet) and dates of “lot blank weighing(s)” are recorded in the quality control logbook. Once the “lot blanks” have stabilized, note the time taken from initial exposure of the filters to attainment of mass stability. This amount of time will be designated the minimum conditioning period before filters from the same lot can be pre-weighed and used for routine sampling. Based upon lot blank tests, all incoming blank filters are conditioned within the balance room for a period of at least seven days prior to being pre-weighed.

Pre-weighing of Unsampled Filters

Record the current balance room conditions (relative humidity and temperature) in the quality control logbook. Ensure that the temperature and the relative humidity is within the allowable limits throughout the preceding 24 hours, and, that filters have been conditioned for at least the minimum time needed to attain mass stability, as determined from the filter lot blanks.

Clean the microbalance-weighing chamber with a fine brush, if necessary. Clean the surfaces near the microbalance with anti static solution or disposable lab wipes moistened with iso-propynol. Clean the forceps used for handling the mass reference weights and the filters prior to each weighing session. Ensure that the forceps to be used are thoroughly dry.

Perform an external calibration of the microbalance prior to beginning the weighing session. Obtain a clean filter cassette, support screen and metal dust cover for the filter to be weighed. Select a new conditioned filter using forceps. Lightly grip the filter only by the outer polypropylene support ring and place the filter onto the static neutralizers. Allow the filter to remain in place on the static neutralizer for at least 30 seconds prior to weighing.

Next, place the filter (using forceps) on the balance pan and close the chamber. At the end of 30 seconds, or when stable, write down the following information to the quality control logbook:

1. Cassette ID/Run number (each support cassette is marked on its rim with an ID)
2. Pre-weight mass of the filter
3. Date of pre-weight measurement
4. Analyst's initials

Place the weighed filter into a filter cassette. Attach the protective metal cover to the cassette. Place the loaded cassette into a cassette tray and carrying case for transport to the field.

Duplicate Weights

For each filter weighing session, at least one filter (minimum of 1 filter, or 10% of the samples weighed) shall be re-weighed for accuracy, and recorded in the laboratory logbook. The filter weights should be within +/- 15 ug.

Laboratory Blanks

For each filter weighing session, at least one lot blank filter shall be re-weighed for accuracy, and recorded in the laboratory logbook. The filter weights should be within +/- 15 ug.

Tracking Documentation & Inspection of Field Samples

Upon receipt of samples from the field, follow the receiving and logging-in procedure outlined in Appendix B. At the time of transfer to the Balance Room, the Chain of Custody Record for each sample should contain the following information and signatures:

INFORMATION	SIGNATURES
1. Date, time filter loaded onto sampler.	Site Operator
2. Date, time filter removed from sampler.	Site Operator
3. Date, time, temperature conditions when filter received.	Balance Room Staff
4. Date, time, temperature conditions when filter begins "conditioning"	Balance Room Staff

Samples must be weighed within 10 days of the sampling date. Any samples exceeding the time limit between sampling and post-weighing must be "flagged" and so noted on the matching 24-Hr Report and reported to the lab supervisor.

Post-Weighing of Field Samples

Calibrate the microbalance as described in an earlier section. After conditioning, remove the sampled filter from the conditioning cabinet and, place them on the bench-top near the microbalance. Using a cassette tool (or the closed end of the forceps), carefully split the cassette holder and lift off the top half. Using forceps, grip the filter only by the outer polypropylene support ring and remove the filter from the bottom portion of the filter cassette. Place it onto the static neutralizer. Allow the filter to remain on the static neutralizer at least 30 seconds prior to weighing.

Next (using forceps) place the filter on the balance pan and close the chamber. Continue with post-weighing procedure outlined in Appendix C. At the end of 30 seconds, or when stable, write down the following information to the quality control logbook:

1. Cassette ID/Run. number (each support cassette is marked on its rim with an ID)
2. Post-weight mass of the filter
3. Date of post-weight measurement
4. Analyst's initials

Place the filter into a labeled petri-slide. Close tightly, place it in a zip lock bag and store in the District freezer (at or below 4°C) for at least one year after the sample was collected.

Field Blanks

A field blank filter cassette shall be prepared and performed at least once per month (generally every 4th or 5th sample). Pre and post field blank measurements should agree to within 30 ug. Results shall be recorded in the laboratory logbook, and forwarded to the ARB in the District's quarterly reports.

Calculations

Filter Loading All samplers utilized in the District provide measurements of the total volume of ambient air passing through the sampler. The mass of particulate matter collected on the Teflon filter during the sampling period is determined by subtracting the initial mass of each filter from the final mass of the filter. Particulate loading is therefore calculated using the following equation:

$$\text{Loading} = ((M_f - M_i) \times 1000) / V$$

where,

Loading = mass concentration of particulate (PM10/2.5) (ug/M3)

M_f = final mass of the conditioned filter after sample collection (mg)

M_i = initial mass of the conditioned filter before sample collection (mg)

1000 = unit conversion factor for milligrams to micrograms

V = total sample volume (M3)

Standard Deviation The standard deviation is calculated using the “nonbiased” or “n-1” method using the following equation:

$$\text{Standard Deviation} = \left(\left(n \sum x^2 - (\sum x)^2 \right) / (n(n-1)) \right)^{0.5}$$

where,

n = number of samples

x = sample value

Records

All sample records will be kept and available for review and verification for a minimum of three (3) years. Records will be retained in the hard copy form (chain of custody records) backed up by electronic copies of the filter run, analysis data, and AIRS submittals. Laboratory records will be kept in the form of laboratory log books. Balance room Temp/RH data will be retained in the form of Dickson circle charts and Davis Instrument logger print-outs. Quarterly reports (LCAQMD PM 2.5 Laboratory Quality Control Summaries) submitted to the ARB, will be retained in hard copy format.

SOP APPENDIX A

Pre-Run Weighing Procedure for 47 mm Teflon Filters

Prior to any filter weighing session, the microbalance is calibrated. First, the microbalance base is checked for level and adjusted as needed. The microbalance should be on, and the display should read "0.000". To ensure maximum stability, the microbalance is left on at all times. If needed, the range of the microbalance should be adjusted to the "Range B", which corresponds to the 250-1 ug scale by pressing the "Range" key. To protect the sensitive microbalance pan from air turbulence, the draft shield door should remain closed when not loading or unloading the balance.

External Calibration Check: Open the draft shield door to allow equilibration to room temperature. After equilibration has been reached (usually within one minute), close the draft shield door. Press the "TARE" key to ensure zero-readout. The display should read "0.000" (The balance zero is rechecked every tenth filter, and a post run zero check is performed at the end of every weigh session - tolerance of +/- 3 ug is allowed). Open the draft shield door. Place a 200-mg working reference standard calibration weight onto the microbalance pan with non-metallic forceps. Close the draft shield door. Record the date, time, temperature, relative humidity, and mass readout in the quality control logbook. If the balance is out of calibration (does not show 200.000 mg), reset the display by pressing the "Cal" key. Record the final mass readout in the logbook. Remove the calibration weight and tare the microbalance as described above. Place a 100-mg working reference standard calibration weight onto the microbalance pan with non-metallic forceps. Close the draft shield door. Record the mass readout in the quality control logbook. An external calibration must be performed daily for each day that filters are pre- or post-weighed, and the 200 mg calibration is rechecked every tenth filter, and a post run cal is performed at the end of every weigh session. A tolerance of +/- 3 ug is allowed.

For each filter weighing session, at least one filter (minimum of 1 filter, or 10% of the samples weighed) shall be re-weighed for accuracy, and recorded in the laboratory logbook. The filter weights should be within +/- 15 ug. For each filter weighing session, at least one lot blank filter shall be re-weighed for accuracy, and recorded in the laboratory logbook. The filter weights should be within +/- 15 ug.

In the quality control logbook, sequentially label the next filter run. Next, place the filter (using forceps) on the balance pan and close the chamber. At the end of 30 seconds, or when stable, write down the following information to the quality control logbook:

1. Cassette ID/Run number (each support cassette is marked on its rim with an ID)
2. Pre-weight mass of the filter
3. Date of pre-weight measurement
4. Analyst's initials

Place the weighed filter into a filter cassette. Attach the protective metal cover to the cassette. Place the loaded cassette into a cassette tray and carrying case for transport to the field.

SOP APPENDIX B

Receiving and Log-in Procedure of Field Samples

Login procedures for scheduled routine samples, field blanks, and trip blank (as well as all make-up and extra run filters) will be carried out in the following manner:

Examine the 24-Hr Sample Report/Field Data Sheet to ensure that all data entries and initials are present. If field data or initials are missing, the filter in question needs to be flagged and stored under refrigeration until consultation with field staff and the lab supervisor determines whether the submitted filter is valid.

Remove each filter individually from the cassette tray and carrying case. Detach the protective metal covers but leave each filter in its filter support cassette for identification purposes. Check the physical appearance of the filters, paying special attention to evidence of contamination and/or filter damage.

If there is evidence of contamination and/or damage to the filter, make note of it in the "Lab Comments" section of the 24-Hr Sample Report/Field Data Sheet and consult with the lab supervisor to determine the appropriate action to take.

Condition the filter on a designated rack for at least 24 hours before weighing. Assemble the filters with their 24-Hr Sample Report/Field Data Sheet in such a manner as to facilitate login into the District's "Air Monitoring" database.

Perform the post run weighing of all filters, following the procedure found in Appendix C.

PM-10 Filters After all information has been added to the District's database, a copy of the complete 24-Hr Sample Report/Field Data Sheet is printed and packaged with the filters for shipment to the ARB for XRF or ICPMS analysis. Using Filemaker's Report layout a summary of samples (quarterly) is printed out and forwarded to the Geysers Air Monitoring Program (GAMP) for inclusion in their quarterly reports.

PM_{2.5} Filters After all information has been added to the District's database, the 24-Hr Sample Report/Field Data Sheet is filed in the balance room. A copy is placed on file in the District office. The filter is packaged in a labeled petri-slide, placed it in a zip lock bag and stored in the District freezer (at or below 4°C) for at least one year after the sample was collected. Sample/run information is uploaded to AIRS on a monthly schedule. A summary is printed out (quarterly) and forwarded to the ARB along with the balance room Quality Assurance Report.

SOP APPENDIX C

Post-Run Weighing Procedure for 47 mm Teflon Filters

Prior to any filter weighing session, the microbalance is calibrated. First, the microbalance base is checked for level and adjusted as needed. The microbalance should be on, and the display should read "0.000". To ensure maximum stability, the microbalance is left on at all times. If needed, the range of the microbalance should be adjusted to the "Range B", which corresponds to the 250-1 ug scale by pressing the "Range" key. To protect the sensitive microbalance pan from air turbulence, the draft shield door should remain closed when not loading or unloading the balance.

External Calibration Check: Open the draft shield door to allow equilibration to room temperature. After equilibration has been reached (usually within one minute), close the draft shield door. Press the "TARE" key to ensure zero-readout. The display should read "0.000" (The balance zero is rechecked every tenth filter, and a post run zero check is performed at the end of every weigh session - tolerance of +/- 3 ug is allowed). Open the draft shield door. Place a 200-mg working reference standard calibration weight onto the microbalance pan with non-metallic forceps. Close the draft shield door. Record the date, time, temperature, relative humidity, and mass readout in the quality control logbook. If the balance is out of calibration (does not show 200.000 mg), reset the display by pressing the "Cal" key. Record the final mass readout in the logbook. Remove the calibration weight and tare the microbalance as described above. Place a 100-mg working reference standard calibration weight onto the microbalance pan with non-metallic forceps. Close the draft shield door. Record the mass readout in the quality control logbook. An external calibration must be performed daily for each day that filters are pre- or post-weighed, and the 200 mg calibration is rechecked every tenth filter, and a post run cal is performed at the end of every weigh session. A tolerance of +/- 3 ug is allowed.

For each filter weighing session, at least one filter (minimum of 1 filter, or 10% of the samples weighed) shall be re-weighed for accuracy, and recorded in the laboratory logbook. The filter weights should be within +/- 15 ug. For each filter weighing session, at least one lot blank filter shall be re-weighed for accuracy, and recorded in the laboratory logbook. The lab blank filter(s) is assumed to have been conditioned, weighed, and set aside for long-term exposure in the same ventilated cabinet where routine samples, field blanks, and trip blanks being conditioned prior to pre- or post-weighing. The filter weights should be within +/- 15 ug.

After conditioning, remove the sampled filter from the conditioning cabinet and, place them on the bench-top near the microbalance. Using a cassette tool (or the closed end of the forceps), carefully split the cassette holder and lift off the top half. Using forceps, grip the filter only by the outer polypropylene support ring and remove the filter from the bottom portion of the filter cassette. Place it onto the static neutralizer. Allow the filter to remain in place on the static neutralizer for at least 30 seconds prior to weighing.

Next, (using forceps) place the filter on the balance pan and close the chamber. At the end of 30 seconds, or when the balance readout is stable, write down the following information to the quality control logbook:

1. Cassette ID/Run. number (each support cassette is marked on its rim with an ID)
2. Post-weight mass of the filter
3. Date of post-weight measurement
4. Analyst's initials

Transfer all applicable information to complete 24-Hr Sample Report/Field Data Sheet.

PM-10 Filters After all information has been added to the District's database, a copy of the complete 24-Hr Sample Report/Field Data Sheet is printed and packaged with the filters for shipment to the ARB for XRF or ICPMS analysis. Using Filemaker's Report layout a summary of samples (quarterly) is printed out and forwarded to the Geysers Air Monitoring Program (GAMP) for inclusion in their quarterly reports.

PM2.5 Filters After all information has been added to the District's database, the 24-Hr Sample Report/Field Data Sheet is filed in the balance room. A copy is placed on file in the District office. The filter is packaged in a labeled petri-slide, placed it in a zip lock bag and stored in the District freezer (at or below 4°C) for at least one year after the sample was collected. Sample/run information is uploaded to AIRS on a monthly schedule. A summary is printed out (quarterly) and forwarded to the ARB along with the balance room Quality Assurance Report.

SOP APPENDIX D

LAKE COUNTY AIR QUALITY MANAGEMENT DISTRICT PM 2.5 DATA PROCEDURE (R&P MODEL 2000)

Downloading the Filter and Interval Data from the R&P using the Palm Vx

Connect the Palm Vx and short cable to the RS-232 port on the front of the sampler below the LCD screen.

Filter Data

On the Palm, open the “File-X-Fer” program and select “new” to initiate a new file. Name the file as the location, followed by an “f” and the date the sample (i.e. Lkpt f 10/16).

With the operating mode on the R&P “Mode: Stop”, press the F3 (Data) button on the keypad once to view the Filter Data screen. Press the “SHIFT” button on the keypad once and then press F5 (Output). The filter data will download and appear on the Palm. Press “Done” on the bottom of the Palm’s touch-screen to close (and save) the file.

Interval Data

Again, within the “File-X-Fer” program, select “new” to initiate a new file. Name the file as the location, followed by an “i” and the date the sample (i.e. Lkpt i 10/16).

With the operating mode on the R&P “Mode: Stop”, press the F3 (Data), and then F5 (Int Data) to view the Interval Data Screen. To capture all of the interval data for the last run, scroll back (-, --, or ---) to the beginning of the sample run before downloading this information. Once you have successfully scrolled back, press the “SHIFT” button on the keypad once and then press F5 (Output). The interval data will start to download and appear on the Palm. After the download is complete (this may take a couple of minutes), press “Done” on the bottom of the Palm’s touch-screen to close (and save) the file.

QAPP Appendix C ARB Data Qualifiers and Flags

Data Qualifiers/ Flags

A sample qualifier or a result qualifier is an indicator of the fact and the reason that the subject analysis (a) did not produce a numeric result, (b) produced a numeric result but it is qualified in some respect relating to the type or validity of the result, or (c) produced a numeric result but for administrative reasons is not to be reported outside the laboratory.

A numeric code is used for invalid data. A code of “Y” or “N” indicates a data flag. A three-letter alphabetic code represents a data flag indicating the data is qualified in some respect and may be invalidated.

Table C-1 Field Qualifiers		
Code	Definition	Description
9977	Contamination	Contamination including observations of insects or other debris
9976	Filter Damage	Filter appeared damaged
Y or N	Elapsed Sample Time	Elapsed sample time out of specification
See Table C-3	Event	Exceptional event expected to have effected sample (dust, fire , spraying etc)
9976	Field Accident	There was an accident in the field that either destroyed the sample or rendered it not suitable for analysis.
FAT	Failed Ambient Temperature Check	Ambient temperature check out of specification
FIT	Failed Filter Temperature Check	Filter temperature check out of specification
Y or N	Flow Rate	Flow rate 5 min avg out of specification
Y or N	Filter Temperature	Filter temperature differential, 30 minute interval out of specification
9995	Failed Multi-point Calibration Verification	Failed the initial Multi point calibration verification
FPC	Failed Pressure Check	Barometric pressure check out of specification
9986	Failed Single Point Calibration Verification	Failed the initial single point calibration verification
9980	Leak suspected	internal/external leak suspected
9980	Sampler Damaged	Sampler appears to be damaged which may have affected filter

Table C-2 Laboratory Qualifiers		
Code	Definition	Description
ALT	Alternate Measurement	The subject parameter was determined using an alternate measurement method. Value is believed to be

		accurate but could be suspect
<2	Below Detectable Limits	There was not a sufficient concentration of the parameter in the sample to exceed the lower detection limit in force at the time the analysis was performed. Numeric results field, if present, is at best an approximate value.
9984	Canceled	The analysis of this parameter was canceled and not performed.
FBK	Found in Blank	The subject parameter had a measurable value above the established QC limit when a blank was analyzed using the same equipment and analytical method. Therefore, the reported value may be erroneous.
FCS	Failed Collocated Sample	Collocated sample exceeded acceptance criteria limits
FFB	Failed Field Blank	Field blank samples exceeded acceptance criteria limits.
9984	Failed Internal Standard	Internal standards exceeded acceptance criteria limits.
9984	Failed Laboratory Blank	Laboratory blank samples exceeded acceptance criteria limits.
9984	Failed Laboratory Duplicate	Laboratory duplicate samples exceeded acceptance criteria limits.
9984	Failed Quality Control	The analysis result is not reliable because quality control criteria were exceeded when the analysis was conducted. Numeric field, if present, is estimated value.
HTE	Holding Time Exceeded	Filter holding time exceeded acceptance criteria limits
9976	Improper Sample Preservation	Due to improper preservation of the sample, it was rendered not suitable for analysis.
9984	Laboratory Accident	There was an accident in the laboratory that either destroyed the sample or rendered it not suitable for analysis.
9984	Rejected	The analysis results have been rejected for an unspecified reason by the laboratory. For any results where a mean is being determined, this data was not utilized in the calculation of the mean.
<2	Analyzed But Undetected	Indicates material was analyzed for but not detected

Table C-3 List of Events for PM_{2.5} Mass Concentrations	
Code	Description
A	High Winds
C	Volcanic eruptions
D	Sandblasting
E	Forest fire
F	Structural fire
G	High pollen count
H	Chemical spills and industrial accidents
J	Construction/demolition
K	Agricultural tilling
L	Highway construction
N	Sanding/salting of streets
O	Infrequent large gatherings
P	Roofing operations
Q	Prescribed burning
R	Clean up after a major disaster
S	Seismic activity

QAPP APPENDIX D

LAKE COUNTY AIR QUALITY MANAGEMENT DISTRICT PM 2.5 AUDIT PROCEDURE (R&P MODEL 2000)

Monthly Audit Check / Quarterly Calibration

The LCAQMD Calibration/Audit procedures for the R&P Model 2000 is performed using the following sequence and method. The method was largely adapted from the manufacturers Partisol FRM published procedures. All Quality Assurance activities are documented on the form attached at the end of this procedure and retained for reference and verification. This procedure includes five different sections as follows:

A. Ambient Temperature Calibration

The external temperature sensor is calibrated by removing the temperature probe from the radiation shield and comparing it with a NIST certified thermometer. Carefully loosen the two Philips screws and slide the temperature probe out from the bottom of the shield. Immerse the probe in a water bath along with a NIST certified thermometer. Set the water bath with probe and thermometer on the left side of the R&P stand below the radiation shield, to equilibrate for five minutes.

During the equilibration period, press <F5: Setup> and <F2: Calib> when in the R&P's Main screen to access the Calibration screen. (the R&P must be in the Stop Operating Mode). When the temperatures are equilibrated, read and record the actual temperature of the water bath. Press <F1: Edit> to enter the Edit Mode, and move the cursor to the "Act" (actual) column in the row labeled "AmbT". Read and record the temperature displayed. Enter the correct temperature (°C) and press "Enter" to leave the Edit Mode. Verify the readings and record the final temperature and the new calibration span.

Remove the temperature probe from the water bath, dry the end and re-install it into the radiation shield in the reverse order of removal.

B. Filter Temperature Calibration

The filter temperature sensor is calibrated in place by comparing it with a NIST certified thermometer. Carefully open the filter platform by pulling on the tray handle. Remove the filter and cassette and store in a clean location. With the filter platform open, place the NIST thermometer into the base of the filter platform adjacent to the temperature probe. Secure the thermometer by holding in place or using a piece of tape and the top of the R&P cabinet. Equilibrate for five minutes.

During the equilibration period, press <F5: Setup> and <F2: Calib> when in the R&P's Main screen to access the Calibration screen. (the R&P must be in the Stop Operating Mode). When the temperatures are equilibrated, read and record the actual temperature. Press <F1: Edit> to enter the Edit Mode, and move the cursor to the "Act" (actual) column in the row

labeled “FltT”. Read and record the temperature displayed. Enter the correct temperature (°C) and press “Enter” to leave the Edit Mode. Verify the readings and record the final temperature and the new calibration span.

Remove the thermometer from the base of the filter platform and re-install the filter and cassette, and close the platform by pushing the tray handle into the locked position.

C. Ambient Pressure Calibration

The pressure sensor is calibrated by comparing it with the laboratory’s mercury barometer (primary standard). The barometric pressure is obtained by reading the mercury level in the barometer (a temperature correction is applied). The units are converted into millimeters of mercury by multiplying the inches by 25.4. Record the actual barometric pressure.

At the sampler, press <F5: Setup> and <F2: Calib> when in the R&P’s Main screen to access the Calibration screen. (the R&P must be in the Stop Operating Mode). Press <F1: Edit> to enter the Edit Mode, and move the cursor to the “Act” (actual) column in the row labeled “Pres”. Read and record the pressure displayed. Enter the correct pressure (mmHg) and press “Enter” to leave the Edit Mode. Verify the readings and record the final pressure and the new calibration span.

D. Flow Audit/Calibration

Before either the single point or five-point flow calibrations are performed, the temperature and pressure calibrations must be performed. In addition, leak checks must also be performed prior to flow calibrations. In addition to the flow procedures, the leak check procedures are presented. To ensure leak tightness and a valid flow calibration, a filter cassette containing a new 47 mm filter must be installed in the sampler.

External Leak Check

Press <F5: Audit> when in the R&P’s Setup screen to access the Audit screen. Remove the sample head from the sampler and install a R&P Flow Audit Adaptor to the end of the sample tube. Turn on the pump and flow by pressing <F2: Pump> and <F1: Valve>. Close the ball valve on the Flow Audit Adapter. Open the white access panel on the front of the instrument located below the filter platform mechanism. Inside, shut off the flow to the flow controller assembly by closing the manual shut off valve attached to the large air filter on the left side of the manifold in the hub. Read and record the reading on the vacuum gauge once the reading is stable. Shut off the flow to the pump by closing the manual shut off valve on the bottom of the manifold in the hub. After 60 seconds read and record the reading on the vacuum gauge. To pass the leak check, the reading shall not drop more than 5” Hg during the 60 second period. This corresponds to a leak of 80 ml/min. Once the instrument passes, open the flow valves in the reverse order that they were closed.

Internal Leak Check

Install a R&P Leak Check Disk over the Teflon filter, re-assemble the cassette and install in the sampler. Turn on the pump and flow by pressing <F2: Pump> and <F1: Valve>. Close the ball valve on the Flow Audit Adapter, read and record the vacuum gauge immediately. Read and record the reading on the vacuum gauge after 30 seconds. To pass the leak check, the reading shall not drop more than 8.5” Hg during the 30 second period. Once the instrument

passes, open the flow valves in the reverse order that they were closed, and remove the R&P Leak Check Disk from the filter cassette.

Note: If the instrument does not pass a leak check, trace the flow path, identify problems in the tubing or connections, and correct the problem. Re-audit after corrections.

Single Point Flow Calibration

Display the Calibration screen by pressing <F5: Setup> and then <F2: Calib> from the Main screen. Connect the Gillian Gillibrator to the R&P Flow Audit Adaptor on the end of the sample tube. A filter cassette containing a new 47 mm filter must be installed in the sampler. Press <F1: Edit> to enter the Edit Mode, and move the cursor to the “Act” (actual) column in the row labeled “Flow”. Enter 0 and press <Enter> to reset the “Offset” which is the zero offset for the flow controller. Read and record the value. Turn on the pump by pressing <F7: Flow> (<Shift> <F2>). Adjust the flow rate in the “Calc” column until it reads 16.7 lpm (use the increase F10, decrease F8 and hold F9 buttons to accomplish this). Once stable at 16.7 lpm, determine the actual flow with the Gilibrator, and record the value. Press <F1: Edit> to enter the Edit Mode, and move the cursor to the “Act” (actual) column in the row labeled “Flow”. Enter the actual flow and press “Enter” to leave the Edit Mode. Verify the readings and record the final flow and the new calibration span. Return to the Main screen by pressing <ESC> twice.

Five Point Flow Calibration

Display the Calibration screen by pressing <F5: Setup> and then <F2: Calib> and then <F2: FlowCal> from the Main screen. Connect the Gillian Gillibrator to the R&P Flow Audit Adaptor on the end of the sample tube. A filter cassette containing a new 47 mm filter must be installed in the sampler. Press <F2: Start> to begin the 5-point calibration routine. In succession determine the each flowrate with the Gilibrator and enter the value by pressing <F1: Edit> and moving the curser to the Actual Flow field, and entering the actual flow. Press <Enter> between readings to advance to the next flowrate. One must wait until each flow has stabilized before measuring the actual flow and entering the value - if you rush things, you can inadvertently end up with a bad calibration. Verify the readings and record the final flow for each and the final zero and span figures. Return to the Main screen by pressing <ESC> twice.

Once the flow calibrations are completed, restore the sampling hardware to the original state and re-install the sampler filter cassette.

E. Time Calibration

The time on the clock operating inside of the R&P is compared to the actual time determined by actual time (Oregon Scientific “Time Machine”). Display the Calibration screen by pressing <F5: Setup> and then pressing <F1: Edit> to enter the Edit Mode, and move the cursor to the “Time” column. Enter the actual time and press “Enter” to leave the Edit Mode. Verify the readings and record the final time.

In addition to the calibrations performed, routine cleaning of the sample head and WINs impactor are performed pursuant to the established manufacturers (R&P) procedures. At the final completion of the calibration activities, the written worksheet

remains available and on file in the Records Section of the District's Balance Room.
The current calibration date is entered into the Monitoring database.

Lake County Air Quality Management District

R&P Model 2000 PM-2.5/10 Sampler Calibration Worksheet

Clean Sample Head _____
Clean WINs Impactor _____
Leak Check System – Ext _____ Int _____

A. Ambient Temperature Calibration

T (C) actual: _____	As Is	% Diff	Final
AmbT _____	_____	_____	_____
AmbT Offset: _____			

B. Filter Temperature Calibration

T (C) actual: _____	As Is	% Diff	Final
FltT _____	_____	_____	_____
FltT Offset: _____			

C. Ambient Pressure Calibration

Pres (mmHg) actual: _____	As Is	% Diff	Final
Pres _____	_____	_____	_____
Pres Offset: _____			

D. Single Point Flow Calibration

Zero Offset: _____	% Diff
Set Calc Flow to 16.7 lpm	_____
Act Flow: _____	Span: _____

E. Five Point Flow Calibration

Zero Offset: _____	Span: _____		
Set Point	As Is	Final	% Diff
16.7	_____	_____	_____
17.5	_____	_____	_____
15.8	_____	_____	_____
18.4	_____	_____	_____
15.0	_____	_____	_____

F. Clock/Timer Verification

Time (PST)	Actual: _____	As Is: _____	Final: _____
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QAPP Appendix E Glossary

GLOSSARY OF QUALITY ASSURANCE AND RELATED TERMS

Acceptance criteria — Specified limits placed on characteristics of an item, process, or service defined in requirements documents. (ASQC Definitions)

Accuracy — A measure of the closeness of an individual measurement or the average of a number of measurements to the true value.

Assessment — The evaluation process used to measure the performance or effectiveness of a system and its elements. As used here, assessment is an all-inclusive term used to denote any of the following: audit, performance evaluation (PE), management systems review (MSR), peer review, inspection, or surveillance.

Audit (quality) — A systematic and independent examination to determine whether quality activities and related results comply with planned operations and whether these operations are implemented effectively and are suitable to achieve objectives.

Audit of Data Quality (ADQ) — A qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data are of acceptable quality.

Authenticate — The act of establishing an item as genuine, valid, or authoritative.

Bias — The systematic or persistent distortion of a measurement process, which causes errors in one direction (i.e., the expected sample measurement is different from the sample's true value).

Blank — A sample subjected to the usual analytical or measurement process to establish a zero baseline or background value. Sometimes used to adjust or correct routine analytical results. A sample that is intended to contain none of the analytes of interest. A blank is used to detect contamination during sample handling preparation and/or analysis.

Calibration — A comparison of a measurement standard, instrument, or item with a standard or instrument of higher accuracy to detect and quantify inaccuracies and to report or eliminate those inaccuracies by adjustments.

Calibration drift — The deviation in instrument response from a reference value over a period of time before recalibration.

Certification — The process of testing and evaluation against specifications designed to document, verify, and recognize the competence of a person, organization, or other entity to perform a function or service, usually for a specified time.

Chain of custody — An unbroken trail of accountability that ensures the physical security of samples, data, and records.

Check standard — A standard prepared independently of the calibration standards and analyzed exactly like the samples. Check standard results are used to estimate analytical precision and to indicate the presence of bias due to the calibration of the analytical system.

Collocated samples — Two or more portions collected at the same point in time and space so as to be considered identical. These samples are also known as field replicates and should be identified as such.

Comparability — A measure of the confidence with which one data set or method can be compared to another.

Completeness — A measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct, normal conditions.

Computer program — A sequence of instructions suitable for processing by a computer. Processing may include the use of an assembler, a compiler, an interpreter, or a translator to prepare the program for execution. A computer program may be stored on magnetic media and referred to as “software,” or it may be stored permanently on computer chips, referred to as “firmware.” Computer programs covered in a QAPP are those used for audit results, design analysis, data acquisition, data reduction, data storage (databases), operation or control, and database or document control registers when used as the controlled source of quality information.

Confidence Interval — The numerical interval constructed around a point estimate of a population parameter, combined with a probability statement (the confidence coefficient) linking it to the population's true parameter value. If the same confidence interval construction technique and assumptions are used to calculate future intervals, they will include the unknown population parameter with the same specified probability.

Conformance — An affirmative indication or judgment that a product or service has met the requirements of the relevant specification, contract, or regulation; also, the state of meeting the requirements.

Consensus standard — A standard established by a group representing a cross section of particular government agencies, industry or trade, or a part thereof.

Contractor — Any organization or individual contracting to furnish services or items or to perform work.

Corrective action — Any measures taken to rectify conditions adverse to quality and, where possible, to preclude their recurrence.

Correlation coefficient — A number between -1 and 1 that indicates the degree of linearity between two variables or sets of numbers. The closer to -1 or +1, the stronger the linear relationship between the two (i.e., the better the correlation). Values close to zero suggest no correlation between the two variables.

Data of known quality — Data that have the qualitative and quantitative components associated with their derivation documented appropriately for their intended use, and when such documentation is verifiable and defensible.

Data Quality Assessment (DQA) — The scientific and statistical evaluation of data to determine if data obtained from environmental operations are of the right type, quality, and quantity to support their intended use. The five steps of the DQA Process include: 1) reviewing the DQOs and sampling design, 2) conducting a preliminary data review, 3) selecting the statistical test, 4) verifying the assumptions of the statistical test, and 5) drawing conclusions from the data.

Data Quality Indicators (DQIs) — The quantitative statistics and qualitative descriptors that are used to interpret the degree of acceptability or utility of data to the user. The principal data quality indicators are bias, precision, accuracy, comparability, completeness, representativeness.

Data Quality Objectives (DQOs) — The qualitative and quantitative statements derived from the DQO Process that clarify a study's technical and quality objectives, define the appropriate type of data, and specify tolerable levels of potential decision errors that will be used as the basis for establishing the quality and quantity of data needed to support decisions.

Data Quality Objectives (DQO) Process — A systematic strategic planning tool based on the scientific method that identifies and defines the type, quality, and quantity of data needed to satisfy a specified use. The key elements of the DQO process include:

- state the problem,
- identify the decision,
- identify the inputs to the decision,
- define the boundaries of the study,
- develop a decision rule,

- specify tolerable limits on decision errors, and
- optimize the design for obtaining data.

DQOs are the qualitative and quantitative outputs from the DQO Process.

Data reduction — The process of transforming the number of data items by arithmetic or statistical calculations, standard curves, and concentration factors, and collating them into a more useful form. Data reduction is irreversible and generally results in a reduced data set and an associated loss of detail.

Data usability — The process of ensuring or determining whether the quality of the data produced meets the intended use of the data.

Deficiency — An unauthorized deviation from acceptable procedures or practices, or a defect in an item.

Design — The specifications, drawings, design criteria, and performance requirements. Also, the result of deliberate planning, analysis, mathematical manipulations, and design processes.

Detection Limit (DL) — A measure of the capability of an analytical method to distinguish samples that do not contain a specific analyte from samples that contain low concentrations of the analyte; the lowest concentration or amount of the target analyte that can be determined to be different from zero by a single measurement at a stated level of probability. DLs are analyte- and matrix-specific and may be laboratory-dependent.

Distribution — 1) The appointment of an environmental contaminant at a point over time, over an area, or within a volume; 2) a probability function (density function, mass function, or distribution function) used to describe a set of observations (statistical sample) or a population from which the observations are generated.

Document — Any written or pictorial information describing, defining, specifying, reporting, or certifying activities, requirements, procedures, or results.

Document control — The policies and procedures used by an organization to ensure that its documents and their revisions are proposed, reviewed, approved for release, inventoried, distributed, archived, stored, and retrieved in accordance with the organization's requirements.

Duplicate samples — Two samples taken from and representative of the same population and carried through all steps of the sampling and analytical procedures in an identical manner. Duplicate samples are used to assess variance of the total method, including sampling and analysis. See also *collocated sample*.

Environmental conditions — The description of a physical medium (e.g., air, water, soil, sediment) or a biological system expressed in terms of its physical, chemical, radiological, or biological characteristics.

Environmental data — Any parameters or pieces of information collected or produced from measurements, analyses, or models of environmental processes, conditions, and effects of pollutants on human health and the ecology, including results from laboratory analyses or from experimental systems representing such processes and conditions.

Environmental monitoring — The process of measuring or collecting environmental data.

Environmental processes — Any manufactured or natural processes that produce discharges to, or that impact, the ambient environment.

Environmental programs — An all-inclusive term pertaining to any work or activities involving the environment, including but not limited to: characterization of environmental processes and conditions; environmental monitoring; environmental research and development; the design, construction, and operation of environmental technologies; and laboratory operations on environmental samples.

Environmental technology — An all-inclusive term used to describe pollution control devices and systems, waste treatment processes and storage facilities, and site remediation technologies and their components that may be utilized to remove pollutants or contaminants from, or to prevent them from entering, the environment.

Examples include wet scrubbers (air), soil washing (soil), granulated activated carbon unit (water), and filtration (air, water). Usually, this term applies to hardware-based systems; however, it can also apply to methods or techniques used for pollution prevention, pollutant reduction, or containment of contamination to prevent further movement of the contaminants, such as capping, solidification or vitrification, and biological treatment.

Estimate — A characteristic from the sample from which inferences on parameters can be made.

Field blank — A blank used to provide information about contaminants that may be introduced during sample collection, storage, and transport. A clean sample, carried to the sampling site, exposed to sampling conditions, returned to the laboratory, and treated as an environmental sample.

Financial assistance — The process by which funds are provided by one organization (usually governmental) to another organization for the purpose of performing work or furnishing services or items. Financial assistance mechanisms include grants, cooperative agreements, and governmental interagency agreements.

Finding — An assessment conclusion that identifies a condition having a significant effect on an item or activity. An assessment finding may be positive or negative, and is normally accompanied by specific examples of the observed condition.

Goodness-of-fit test — The application of the chi square distribution in comparing the frequency distribution of a statistic observed in a sample with the expected frequency distribution based on some theoretical model.

Guidance — A suggested practice that is not mandatory, intended as an aid or example in complying with a standard or requirement.

Guideline — A suggested practice that is not mandatory in programs intended to comply with a standard.

Holding time — The period of time a sample may be stored prior to its required analysis.

Identification error — The misidentification of an analyte. In this error type, the contaminant of concern is unidentified and the measured concentration is incorrectly assigned to another contaminant.

Independent assessment — An assessment performed by a qualified individual, group, or organization that is not a part of the organization directly performing and accountable for the work being assessed.

Inspection — The examination or measurement of an item or activity to verify conformance to specific requirements.

Internal standard — A standard added to a test portion of a sample in a known amount and carried through the entire determination procedure as a reference for calibrating and controlling the precision and bias of the applied analytical method.

Laboratory split samples — Two or more representative portions taken from the same sample and analyzed by different laboratories to estimate the interlaboratory precision or variability and the data comparability.

Limit of quantitation — The minimum concentration of an analyte or category of analytes in a specific matrix that can be identified and quantified above the method detection limit and within specified limits of precision and bias during routine analytical operating conditions.

Management — Those individuals directly responsible and accountable for planning, implementing, and assessing work.

Management system — A structured, nontechnical system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for conducting work and producing items and services.

Management Systems Review (MSR) — The qualitative assessment of a data collection operation and/or organization(s) to establish whether the prevailing quality management structure, policies, practices, and procedures are adequate for ensuring that the type and quality of data needed are obtained.

Matrix spike — A sample prepared by adding a known mass of a target analyte to a specified amount of matrix sample for which an independent estimate of the target analyte concentration is available. Spiked samples are used, for example, to determine the effect of the matrix on a method's recovery efficiency.

May — When used in a sentence, a term denoting permission but not a necessity.

Mean (arithmetic) — The sum of all the values of a set of measurements divided by the number of values in the set; a measure of central tendency.

Mean squared error — A statistical term for variance added to the square of the bias.

Measurement and Testing Equipment (M&TE) — Tools, gauges, instruments, sampling devices, or systems used to calibrate, measure, test, or inspect in order to control or acquire data to verify conformance to specified requirements.

Memory effects error — The effect that a relatively high concentration sample has on the measurement of a lower concentration sample of the same analyte when the higher concentration sample precedes the lower concentration sample in the same analytical instrument.

Method — A body of procedures and techniques for performing an activity (e.g., sampling, chemical analysis, quantification), systematically presented in the order in which they are to be executed.

Method blank — A blank prepared to represent the sample matrix as closely as possible and analyzed exactly like the calibration standards, samples, and quality control (QC) samples. Results of method blanks provide an estimate of the within-batch variability of the blank response and an indication of bias introduced by the analytical procedure.

Mid-range check — A standard used to establish whether the middle of a measurement method's calibrated range is still within specifications.

Must — When used in a sentence, a term denoting a requirement that has to be met.

Nonconformance — A deficiency in a characteristic, documentation, or procedure that renders the quality of an item or activity unacceptable or indeterminate; nonfulfillment of a specified requirement.

Objective evidence — Any documented statement of fact, other information, or record, either quantitative or qualitative, pertaining to the quality of an item or activity, based on observations, measurements, or tests that can be verified.

Observation — An assessment conclusion that identifies a condition (either positive or negative) that does not represent a significant impact on an item or activity. An observation may identify a condition that has not yet caused a degradation of quality.

Organization — A company, corporation, firm, enterprise, or institution, or part thereof, whether incorporated or not, public or private, that has its own functions and administration.

Organization structure — The responsibilities, authorities, and relationships, arranged in a pattern, through which an organization performs its functions.

Outlier — An extreme observation that is shown to have a low probability of belonging to a specified data population.

Parameter — A quantity, usually unknown, such as a mean or a standard deviation characterizing a population. Commonly misused for "variable," "characteristic," or "property."

Peer review — A documented critical review of work generally beyond the state of the art or characterized by the existence of potential uncertainty. Conducted by qualified individuals (or an organization) who are independent

of those who performed the work but collectively equivalent in technical expertise (i.e., peers) to those who performed the original work. Peer reviews are conducted to ensure that activities are technically adequate, competently performed, properly documented, and satisfy established technical and quality requirements. An in-depth assessment of the assumptions, calculations, extrapolations, alternate interpretations, methodology, acceptance criteria, and conclusions pertaining to specific work and of the documentation that supports them. Peer reviews provide an evaluation of a subject where quantitative methods of analysis or measures of success are unavailable or undefined, such as in research and development.

Performance Evaluation (PE) — A type of audit in which the quantitative data generated in a measurement system are obtained independently and compared with routinely obtained data to evaluate the proficiency of an analyst or laboratory.

Pollution prevention — An organized, comprehensive effort to systematically reduce or eliminate pollutants or contaminants prior to their generation or their release or discharge into the environment.

Population — The totality of items or units of material under consideration or study.

Precision — A measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions expressed generally in terms of the standard deviation.

Procedure — A specified way to perform an activity.

Process — A set of interrelated resources and activities that transforms inputs into outputs. Examples of processes include analysis, design, data collection, operation, fabrication, and calculation.

Project — An organized set of activities within a program.

Qualified data — Any data that have been modified or adjusted as part of statistical or mathematical evaluation, data validation, or data verification operations.

Qualified services — An indication that suppliers providing services have been evaluated and determined to meet the technical and quality requirements of the client as provided by approved procurement documents and demonstrated by the supplier to the client's satisfaction.

Quality — The totality of features and characteristics of a product or service that bears on its ability to meet the stated or implied needs and expectations of the user.

Quality Assurance (QA) — An integrated system of management activities involving planning, implementation, assessment, reporting, and quality improvement to ensure that a process, item, or service is of the type and quality needed and expected by the client.

Quality Assurance Program Description/Plan — See *quality management plan*.

Quality Assurance Project Plan (QAPP) — A formal document describing in comprehensive detail the necessary quality assurance (QA), quality control (QC), and other technical activities that must be implemented to ensure that the results of the work performed will satisfy the stated performance criteria. The QAPP components are divided into four classes: 1) Project Management, 2) Measurement/Data Acquisition, 3) Assessment/Oversight, and 4) Data Validation and Usability. Guidance and requirements on preparation of QAPPs can be found in EPA QA/R-5 and QA/G-5.

Quality Control (QC) — The overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are used to fulfill requirements for quality. The system of activities and checks used to ensure that measurement systems are maintained within prescribed limits, providing protection against "out of control" conditions and ensuring the results are of acceptable quality.

Quality control (QC) sample — An uncontaminated sample matrix spiked with known amounts of analytes from a source independent of the calibration standards. Generally used to establish intra-laboratory or analyst-specific precision and bias or to assess the performance of all or a portion of the measurement system.

Quality improvement — A management program for improving the quality of operations. Such management programs generally entail a formal mechanism for encouraging worker recommendations with timely management evaluation and feedback or implementation.

Quality management — That aspect of the overall management system of the organization that determines and implements the quality policy. Quality management includes strategic planning, allocation of resources, and other systematic activities (e.g., planning, implementation, and assessment) pertaining to the quality system.

Quality Management Plan (QMP) — A formal document that describes the quality system in terms of the organization's structure, the functional responsibilities of management and staff, the lines of authority, and the required interfaces for those planning, implementing, and assessing all activities conducted.

Quality system — A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products, and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required quality assurance (QA) and quality control (QC).

Readiness review — A systematic, documented review of the readiness for the start-up or continued use of a facility, process, or activity. Readiness reviews are typically conducted before proceeding beyond project milestones and prior to initiation of a major phase of work.

Record (quality) — A document that furnishes objective evidence of the quality of items or activities and that has been verified and authenticated as technically complete and correct. Records may include photographs, drawings, magnetic tape, and other data recording media.

Recovery — The act of determining whether or not the methodology measures all of the analyte contained in a sample.

Repeatability — The degree of agreement between independent test results produced by the same analyst, using the same test method and equipment on random aliquots of the same sample within a short time period.

Reporting limit — The lowest concentration or amount of the target analyte required to be reported from a data collection project. Reporting limits are generally greater than detection limits and are usually not associated with a probability level.

Representativeness — A measure of the degree to which data accurately and precisely represent a characteristic of a population, a parameter variation at a sampling point, a process condition, or an environmental condition.

Reproducibility — The precision, usually expressed as variance, that measures the variability among the results of measurements of the same sample at different laboratories.

Requirement — A formal statement of a need and the expected manner in which it is to be met.

Research (applied) — A process, the objective of which is to gain the knowledge or understanding necessary for determining the means by which a recognized and specific need may be met.

Research (basic) — A process, the objective of which is to gain fuller knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific applications toward processes or products in mind.

Research development/demonstration — The systematic use of the knowledge and understanding gained from research and directed toward the production of useful materials, devices, systems, or methods, including prototypes and processes.

Round-robin study — A method validation study involving a predetermined number of laboratories or analysts, all analyzing the same sample(s) by the same method. In a round-robin study, all results are compared and used to develop summary statistics such as interlaboratory precision and method bias or recovery efficiency.

Ruggedness study — The carefully ordered testing of an analytical method while making slight variations in test conditions (as might be expected in routine use) to determine how such variations affect test results. If a variation affects the results significantly, the method restrictions are tightened to minimize this variability.

Scientific method — The principles and processes regarded as necessary for scientific investigation, including rules for concept or hypothesis formulation, conduct of experiments, and validation of hypotheses by analysis of observations.

Self-assessment — The assessments of work conducted by individuals, groups, or organizations directly responsible for overseeing and/or performing the work.

Sensitivity — the capability of a method or instrument to discriminate between measurement responses representing different levels of a variable of interest.

Service — The result generated by activities at the interface between the supplier and the customer, and the supplier internal activities to meet customer needs. Such activities in environmental programs include design, inspection, laboratory and/or field analysis, repair, installation, and calibration.

Shall — A term denoting a requirement that is mandatory whenever the criterion for conformance with the specification permits no deviation. This term does not prohibit the use of alternative approaches or methods for implementing the specification so long as the requirement is fulfilled.

Should — A term denoting a guideline or recommendation whenever noncompliance with the specification is permissible.

Significant condition — Any state, status, incident, or situation of an environmental process or condition, or environmental technology in which the work being performed will be adversely affected sufficiently to require corrective action to satisfy quality objectives or specifications and safety requirements.

Software life cycle — The period of time that starts when a software product is conceived and ends when the software product is no longer available for routine use. The software life cycle typically includes a requirement phase, a design phase, an implementation phase, a test phase, an installation and check-out phase, an operation and maintenance phase, and sometimes a retirement phase.

Span check — A standard used to establish that a measurement method is not deviating from its calibrated range.

Specification — A document stating requirements and referring to or including drawings or other relevant documents. Specifications should indicate the means and criteria for determining conformance.

Spike — A substance that is added to an environmental sample to increase the concentration of target analytes by known amounts; used to assess measurement accuracy (spike recovery). Spike duplicates are used to assess measurement precision.

Split samples — Two or more representative portions taken from one sample in the field or in the laboratory and analyzed by different analysts or laboratories. Split samples are quality control (QC) samples that are used to assess analytical variability and comparability.

Standard deviation — A measure of the dispersion or imprecision of a sample or population distribution expressed as the positive square root of the variance and has the same unit of measurement as the mean.

Standard Operating Procedure (SOP) — A written document that details the method for an operation, analysis, or action with thoroughly prescribed techniques and steps and that is officially approved as the method for performing certain routine or repetitive tasks.

Supplier — Any individual or organization furnishing items or services or performing work according to a procurement document or a financial assistance agreement. An all-inclusive term used in place of any of the following: vendor, seller, contractor, subcontractor, fabricator, or consultant.

Surrogate spike or analyte — A pure substance with properties that mimic the analyte of interest. It is unlikely to be found in environmental samples and is added to them to establish that the analytical method has been performed properly.

Surveillance (quality) — Continual or frequent monitoring and verification of the status of an entity and the analysis of records to ensure that specified requirements are being fulfilled.